Master's degree thesis

LOG950 Logistics

An analysis of Shipping Lines` selection criteria when choosing European Container Terminals

Bernt Christoffer Aaby

Number of pages including this page: 77

Molde, 25.05.2012

Molde University College

Mandatory statement

Each student is responsible for complying with rules and regulations that relate to examinations and to academic work in general. The purpose of the mandatory statement is to make students aware of their responsibility and the consequences of cheating. Failure to complete the statement does not excuse students from their responsibility.

*Please complete the mandatory statement by placing a mark **in each box** for statements 1-6 below.*		
1.	**I/we herby declare that my/our paper/assignment is my/our own work, and that I/we have not used other sources or received other help than is mentioned in the paper/assignment.**	☒
2.	**I/we herby declare that this paper** 1. Has not been used in any other exam at another department/university/university college 2. Is not referring to the work of others without acknowledgement 3. Is not referring to my/our previous work without acknowledgement 4. Has acknowledged all sources of literature in the text and in the list of references 5. Is not a copy, duplicate or transcript of other work	Mark each box: 1. ☒ 2. ☒ 3. ☒ 4. ☒ 5. ☒
3.	**I am/we are aware that any breach of the above will be considered as cheating, and may result in annulment of the examinaion and exclusion from all universities and university colleges in Norway for up to one year, according to the Act relating to Norwegian Universities and University Colleges, section 4-7 and 4-8 and Examination regulations** section 14 and 15.	☒
4.	**I am/we are aware that all papers/assignments may be checked for plagiarism by a software assisted plagiarism check**	☒
5.	**I am/we are aware that Molde University college will handle all cases of suspected cheating according to prevailing guidelines.**	☒
6.	**I/we are aware of the University College`s rules and regulation for using sources**	☒

Publication agreement

ECTS credits: 30

Supervisor: Naima Saeed

Agreement on electronic publication of master thesis

Author(s) have copyright to the thesis, including the exclusive right to publish the document (The Copyright Act §2).
All theses fulfilling the requirements will be registered and published in Brage HiM, with the approval of the author(s).
Theses with a confidentiality agreement will not be published.

I/we hereby give Molde University College the right to, free of charge, make the thesis available for electronic publication: ☒**yes** ☐**no**

Is there an agreement of confidentiality? ☐**yes** ☒**no**

(A supplementary confidentiality agreement must be filled in)

- If yes: **Can the thesis be online published when the period of confidentiality is expired?** ☐**yes** ☐**no**

Date: 25.05.2012

Acknowledgement

In the process of this study I had a large number of conversations with liner companies and agencies. I am very thankful for all the help these persons have provided me. The quality of this study has relied on their reply on the distributed the survey.

I am also very grateful towards my supervisor for guidance while writing this thesis.

Abstract

This thesis examines Container Shipping Lines selection criteria when selecting European Container Terminals. Data have been collected through distribution of a questionnaire. This questionnaire has been sent out to inter- and intra-regional shipping lines calling three predetermined case ports. These three ports are the Port of Rotterdam, Port of Antwerp and Port of Hamburg. The ports are the main container hubs in Europe (measured in the number TEU handled through a year).

The modern sea transportation system consists of ports operating in a Hub and Spoke system, where the inter-regional carriers transport cargo between regions from hub to hub. These hubs are logistical hubs fully integrated in supply chains. The intra-regional carriers distributed cargo within the region.

The survey was constructed to detect port selection behavior from a supply chain perspective and different port selection criteria are found based on prior research on port attractiveness and port selection.

Descriptive statistics found that loading/discharging rate, handling charges and service quality as the main attributes influencing port selection. Navigational availability, level of congestion, efficiency of hinterland transport and location are important selection criteria. The least important selection criteria was structure of port authorities and ownership, number of vessels calling, personal contacts, investments done by shipping line and value added activities. The analysis found that hinterland connections are more important than the value added activities. This states that ports should focus more on developing good hinterland connections rather than extending the services offered by the port.

Factor analysis found, through Principal Component Analysis and Verimax rotation, that 12 variables (attributes of port attractiveness) could be loaded on to two components; *Ports` specific attributes* and *Formal and informal relationships between ports and shipping lines*.

An analysis of the efficiency of the ports, through use of multiple regression, found that an increase in the number of TEUs increases the total stay at berth and that non-geared vessels have lower total stay at berth than geared vessel.

Contents

1.0 Introduction

The thesis "*An analysis of Shipping Lines` selection criteria when choosing of European Container Terminals*" researches the field of port optimization. The purpose of the thesis is to detect which criteria are important for Liners when selecting ports of call, and is based on associated professor Naima Saeed PhD theses paper on "*Carriers` selection criteria when choosing container terminals in Pakistan*". The thesis will apply a similar approach to solve the research problem in European ports. However, Saeed (2009) work was limited to Pakistani ports. Therefore, results obtained from this research also will be helpful for quantitative comparisons between Asian and European ports, which – combined with the Pakistani case – can have interesting implications for solving specific problems for ports.

The thesis consists of eight chapters, beneath is a brief description of the content in each chapter.

- Chapter One gives an introduction of the thesis, an introduction of the research area and presents the research questions.
- Chapter Two present the ports used as case study
- Chapter Three presents the theoretical framework and offer an overview over prior research of "Port optimization" in respect to port selection criteria and highlights different attributes of a port that influences their attractiveness.
- Chapter Four gives a description of the research methodology. This chapter provides thorough descriptions of the research design, research framework, data collection and the method of analysis.
- Chapter Five contains the analysis of the primary data.
- Chapter Six present the findings of the paper and states the conclusion of the thesis
- Chapter Seven gives a description of the limitations of the thesis and offers recommendation for further research.
- Chapter Eight provides the list of references used in this thesis.
- Chapter Nine present the different appendixes that is referred in this thesis.

This study focuses on Container Liners selection criteria when choosing ports of call in the European market. The paper will use the ports of Rotterdam, Antwerp and Hamburg as case studies.

The following subchapters will briefly go through ports, international trade, the characteristics of shipping lines and finally the research questions are presented.

1.1 Ports

Ports service multiple roles in the maritime industry, and are part of a complex network of players. The port works as an interface linking sea and land transport. There are a large number of definitions of ports. A few will be presented below. A simple definition of ports can be taken from Stopfords (2009, pp. 81) book *Maritime Economics* where ports are defined as;

> *"A geographical area where ships are brought alongside land to load and discharge cargo – usually a deep-water area such as a bay or river mouth".*

This definition is quite simple, but it gives an explanation of the fundamental role of a port. At the same time it is important to see that ports role is more intricate than just a location by the sea. Today ports are a major player in the global transportations system, without ports the merchandise vessel would not have any place to load or discharge cargo and then again serve no purpose; therefore ports can be seen as enabler of seaborne trade to a region.

The same applies to regions without ports or regions that are landlocked; this excludes them from being in direct contact with the physical flow of seaborne trade. These regions have to rely on the ripple effect from seaborne trade at other regions, e.g. the European Market where countries like Switzerland, Czech Republic, Austria, Hungary, Slovakia and so on are landlocked. Though, it is important to note that some of these countries have small ports that serve single purposes which are linked with the ocean through inland waterways.

The magnitude of seaborne trade has more than doubled in volume since the nineteen eighties and in 2007 almost 90 percentage of the world trade was handled through ports (Lee and Hsu, 2007). Ports are a catalyst for economic activity in a region and the effect of this makes it highly attractive for a region to have large ports. Fynes et al (2008) recognize the ports as a key component in the determination of regions and countries overall competitiveness of national economies. Port activities are in some countries the main economical driver, e.g. Singapore.

This tells us that ports are more than a geographical area for loading and discharging of cargo, and something more complex. The recent studies (Hall et al, 2011, pp. 83) have focused on ports role in the global supply chain as a "*physical manifestation of the logistical functions that these locations serve in the overall global trade in commodities"*. This definition explains the complexity of the chain of activities which ports operate in. This is reflected in the definition of a port given in the Port of Antwerp (2010) annual rapport which states:

> *"The port as a link in an interconnected logistics chain that stretches from the overseas "foreland" to the continental hinterland, in a continuous flow of goods without borders"*

Notteboom (2010) concludes in his article *Concentration and the formation of multi-port gateway regions in the European container port system: an update* that "*European ports are increasingly functioning not as individual places that handle ships but within supply chains and networks"*. Lam and Yap (2011) defines ports as "*an integral platform serving as a base for production, trading, logistics and information transfer"*, the authors further state that the performance of a port is provide a competitive advantage for the region and ports role as economics catalyst for regions.

Regions therefore compete for shares of the seaborne trade and ports have to meet the customer requirements in order to be attractive to call. The scope of operations a port can handle is defined by its size and infrastructure. The different cargo segments have different requirements to port infrastructure. The different cargo segments are dry bulk, wet bulk, specialized cargo and general cargo. As stated above this thesis focuses on transport of container which is under the general cargo segment.

The economic activity ports create in regions attracts intra-regional competition for markets shares between ports, in addition to the inter-regional competition. Goss (1990) has defined three levels of port competition:

1. Competition between port ranges.
2. Competition between ports in the same range.
3. Competition between operators in the same port.

The competition between ports is defined by Huybrechts et al (2002) as influenced by five main points:

1. The specific demand from consumers
2. The specific factors of production
3. The supporting industries connected with each operator
4. The specific competencies of each operator and their rivals
5. The structure of port authorities and other public bodies.

These five points address the trade balance between import and export, the integration between industries and operators, the level of competency of operators and their rivals and the structure of port authorities.

1.1.1 Port development and structure

As mentioned above, ports need to facilitate its infrastructure according to the standards of the different cargo segments in order to meet customer requirements (Lee and Cullinane, 2005). Branch (2007, pp. 396) defines that the ports main development is driven by market research and the port authorities and the ship owners need to change according to a shifting market and the arising market opportunities. The level of infrastructure determines its scope of operations. The different cargo segments has own requirements to the port, e.g. requirements on quay, loading and discharging equipment, storage area, warehousing and hinterland transportation methods. Port infrastructure requires large areas both on land and in the surrounding sea. Investments in port infrastructure are costly. Branch (2007) states that these investments in infrastructure are crucial for the ports in order to maintain its competitive advantages.

The importance of a port in a socio-economic perspective has traditionally influenced ports to be owned by public bodies where the port authorities act as landlord renting/leasing out infrastructure and port areas in long term contracts to e.g. terminal operators and logistical companies. Branch (2007) describes an ongoing process of port privatization where governments are outsourcing port management with the objective of increasing the ports attractiveness. The aim is to improve foreign capital investments, raise productivity and stimulate trade. The modernization of ports is a key element of the development of regional trading and distribution centers. These regional centers are based on by the existence of infrastructure and hinterland connections.

Stopford describe in his book *Maritime Economics* (2009) four levels of port development. The different levels are differing on the level of infrastructure. The four levels are:

Level 1: Small Local Ports
Level 2: Large Local Ports
Level 3: Large Regional Ports
Level 4: Regional Distribution Centre

The Small Local Ports (level 1) have a general-purpose terminal with a quayside with cranes and possibility for warehousing. These ports receive and ship a small amount of cargo volumes for local transportation, most often intra-regional. These ports are mainly serviced by short-sea vessels which can accommodate for a mixture of different means of transportation of general cargo, e.g. containers, pallets, commodities in packed form. These types of ports are mainly found in developing countries and in the rural areas of developed countries and regions.

Level 2, Large Local Ports are more developed than the small local ports. These ports can accommodate a larger variety of cargo, and has multipurpose terminals. The port infrastructure is more customized to larger operations. The ports has often an own dry bulk terminal that can accept and moor larger bulk carriers. The ports have warehousing for break bulk and open storage for packing-bulk cargoes.

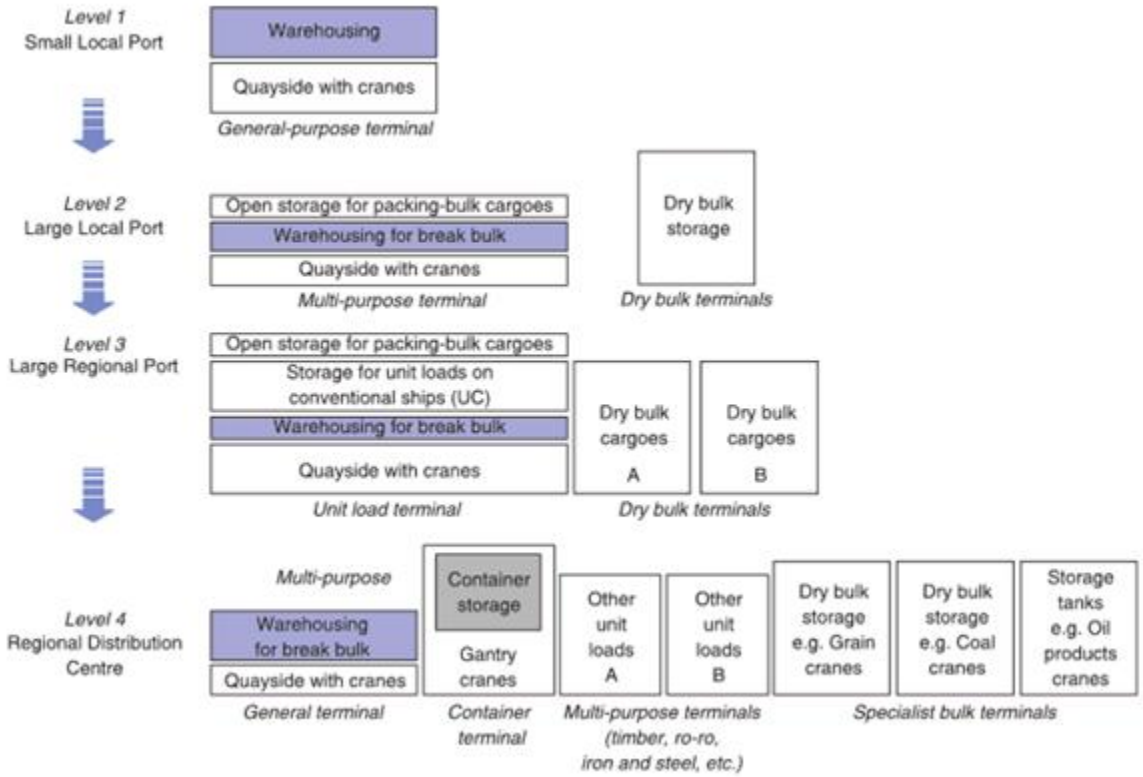
The Large Regional Ports of level 3 has larger cargo volume and has invested more in specialized equipment to handle larger operations than large local ports. The ports typically have in addition storage for unit loads on conventional ships, several terminals, more handling equipment e.g. gantry cranes, more storage space and a larger network of hinterland connections modes, e.g. rail and truck access.

Level 4 ports, Regional Distribution Centre, serves as a logistical hub in its region and distributes cargo intra-regional and inter-regionally. These ports operate in a specific market, e.g. the European market, and receive goods from other regions and redistribute the cargo further out in the hinterland, either by sea, inland waterways, truck, rail or pipe. These five are the essential modes of transport (Mangan, 2012). And likewise receives cargo from the hinterland and distribute it out intra-regional or inter-regionally. These ports have specialized terminals for the different cargo segments and are equipped for cargo handling and can accommodate and moor the largest deep sea going vessels. These

ports have an extensive network of hinterland connections for transshipment of cargo. Examples on European Regional Distribution Centre are Rotterdam as the premier port, followed by Hamburg, Bremen and Antwerp on cargo volume (Stopford, 2009). The leading container distribution centers are the ones used as case study in this thesis.

The figure *Four levels of port development* (figure 1) shows the four levels of port development describe above:

Figure 1: Four levels of port development (Stopford, 2009)



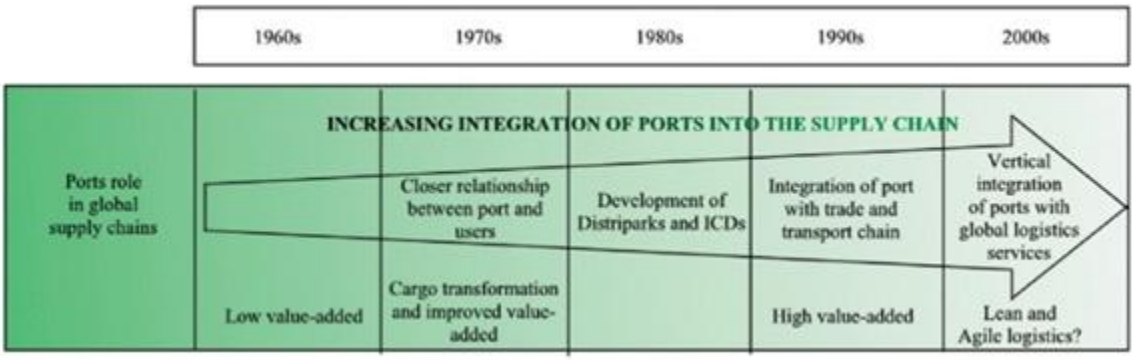
The change in the structure of global trade has influenced shippers to adapt from viewing transportation of cargo from seaport-to-seaport basis, over to viewing the international distribution network in its entirety where ports are a part of a larger value chain (Branch, 2007). The increased focus on global logistics supply chains have implemented the seaborne trade to operate in hub and spoke system where the regional distribution centers distributed cargo between each other and in-and-out to smaller ports in the region.

Hall et al (2011) describes the gateway hubs as essential port to call for shipping lines based on the rich and extensive hinterland markets the port serve. The ports may not be optimal to call but essentially based on the trade flows at the port. E.g. the ports of

Antwerp and Hamburg which lies on rivers of the coast line – requiring more shipment time in and out of the river in comparison to ports which lies on the coast line, e.g. Le Havre and Rotterdam.

Pettit and Beresford (2009) discuss in their article "*From gateways to logistical hubs*" ports role in a supply chain. They illustrate the development ports have had in global supply chains. The illustration present the ports increased focus on value added services and integration into supply chains through the last decade (as shown in figure 2).

Figure 2: Increasing integration of ports into the supply chain



They further states that effect from globalization has forces ports to adapt and develop in order to maintain its competitive advantages. Thus allowing the supply chain they operate in to maintain its competitiveness, where the overall aim of the supply chain is to improve productivity.

Marlow and Casaca (2003) present three areas where ports can contribute to more cost-efficient logistics system:

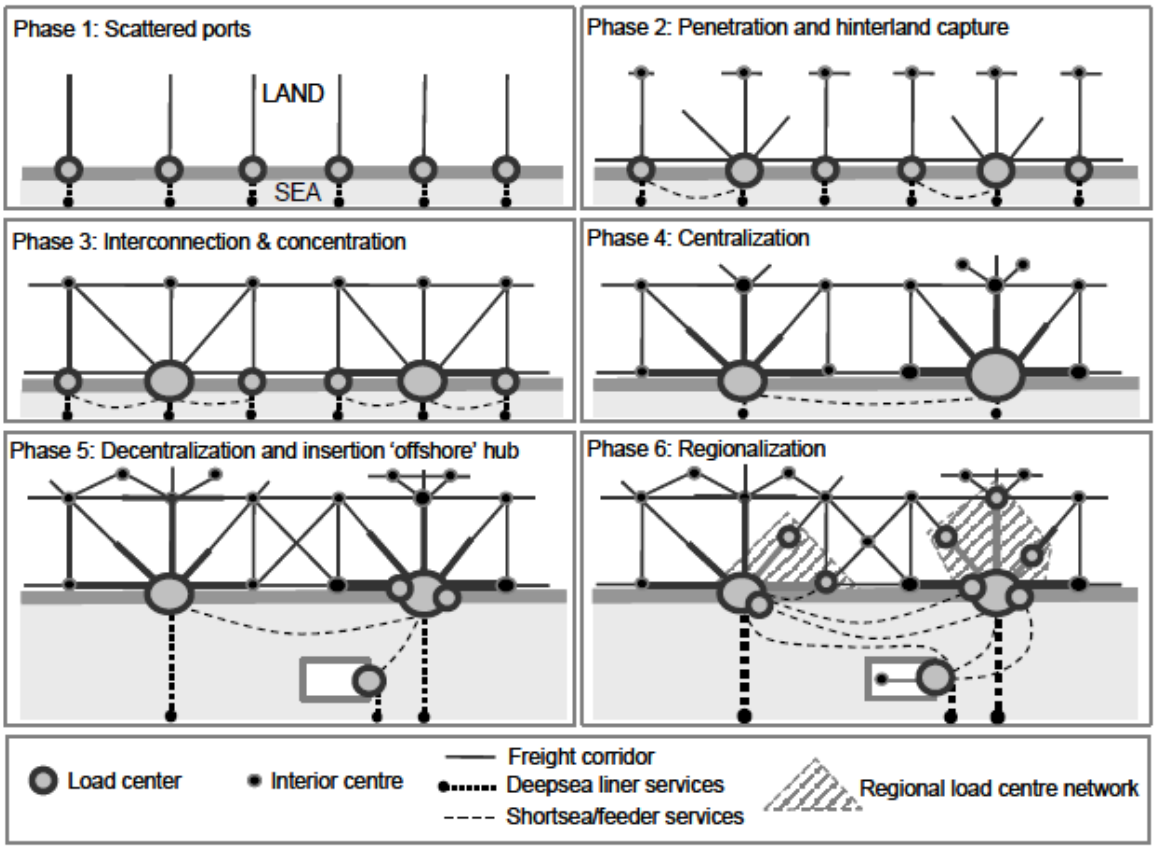
1. Storage cost
2. Translation of storage cost into value
3. Concentration of port operations

Nam and Song (2011) have proposed a definition on Maritime logistics hub as;

> *"A maritime logistics hub is a nodal point of cargo transit or transshipment assuring flawless door-to-door cargo movements, a principal distribution centre functioning as a temporary storage and sorting and a place creating and facilitating value-added services on the regional and/or international scale. "*

Notteboom and Rodrigue (2007) present a new phase in port development in their article *Port Regionalization: towards a new phase in port development.* The article presents the model *The spatial development of a port system* (figure 3). This model is an extension of the models of Hayuth (1956) and Barke (1981) which include a new phase; regionalization phase.

Figure 3: The spatial development of a port system (Notteboom and Rodrigue, 2007)



1.2 International trade

In order to understand why countries trade, international trade theories have been developed. These theories aim to explain the reason for trade between countries. Underneath the four most commonly theories on international trade are presented.

The first defined trade theory was Adams Smith`s *Theory of Absolute Advantage* from 1776. This theory states that one nation can produce a certain product more efficiently than other countries, and will trade it with countries that produce other goods more efficiently. David Ricardo states in his *Theory of Comparative Advantage* from 1817 that a nation will

trade with one another as long as they can produce a certain goods relatively more efficiently than one another (David and Stewart, 2008).

The economic theory *The Factor Endowment Theory* by Heckscher and Ohlin from 1933 was built on Ricardo`s *Theory of Comparative Advantages* and states that a country will enjoy a comparative advantage over other countries if it is naturally endowed with a greater abundance of one of the factors of economic production (David and Stewart, 2008).

Raymond Vernon`s theory *The International Product Life Cycle* from 1966 explains international trade between countries in three stages and that product will over its life cycle be manufactured in different countries. The first stage a company creates a new product to satisfy a market need. At the second stage the product is in demand from other regions and the product is being copied by local manufactures. At the third stage the product technology is generally known and the product is manufactured in low-cost countries (David and Stewart, 2008).

These four theories explain reasons for trade between countries. This trade needs transportation. The choice of transportation modes depend on the location of the two countries, the available infrastructure, the value of the cargo and the shape and size of the cargo. The transportation infrastructure can be grouped into six types; port, canals and waterways, air, rail, road and warehousing (David and Stewart, 2008). The main elements of port infrastructures is the depth of water, bridge clearance, cranes, port operations, warehousing space, connections with land-based transportation services and port capacity. These elements are interconnected and are decisive on the scope of operations a port can handle. Lun et al (2010, pp. 51) describes the demand for container services as derived from the demand for container trade. Container trade is linked up with the international trade. Therefore a growth or decline in the international trade will influence the demand for container trade. As seen after the economic crises of 2008.

Magala and Sammons paper *A New Approach to Port Choice Modelling* (2008) suggest a new approach to port choice modeling. The paper states that shippers no longer choose ports but supply chain, this because of the progressive integration of ports in supply chains. The authors see ports as an implemented element in supply chains where the freight is provided by on logistical firm that offer optimized transportation, gaining the

whole supply chain and states; *Ports no longer can expect to be attractive solely on location because of; "major port clients are now likely to choose ports not simply on their efficiency and location advantages but rather on the quality and reliability of the entire supply chain"*.

A supply chain is defined by Waters (2009, pp. 9) as:

> *"A supply chain consists of the series of activities and organizations that materials move through on their journey from initial suppliers to customer."*

Supply chain management is defined by *The Council of Supply Chain Management Professionals* as (David and Stewart, 2008, pp. 21):

> *"Supply Chain Management (SCM) encompasses the planning and management of all activities involved in sourcing and procurement, conversion, and all logistics management activities. Importantly, it also includes coordination and collaboration with canal partners, which can be suppliers, intermediaries, third-party service providers and customers. In essence, Supply Chain Management integrates supply and demand management within and across companies"*

Waters (2009) state that logistics are responsible for the flow of material through the supply chain. The Supply Chain Management is planning and managing the flow. The aim of the logistics is to help the organization to achieve customer satisfaction. Mangan (2012) describes that the purpose of SCM is to create value and enhance efficiency and satisfy customers.

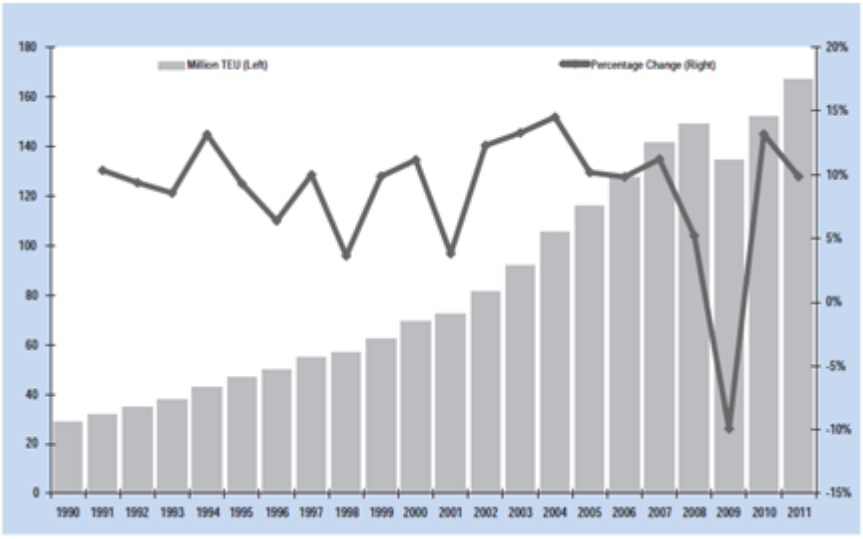
The two following subchapters will go through containerization and container trade flows.

1.2.1 Containerization

A container is a standardized metal box for storage of goods for transportation. The "box" comes in three standard lengths of 20, 40 and 45 ft. and a width of 8 ft. Branch (2007, pp. 346) defines containerizations as; *"a method of distributing merchandise in a unitized form thereby permitting an intermodal transport system to be developed providing a possible combination of rail, road, canal and maritime transport*". The standard container is called TEU (used in the rest of this paper) - short for twenty-foot equivalent unit – and is an intermodal platform which can be transferred between different transportation modes. The entrance of containerization in trade has revolutionized global trade and transportation and shifted the transportation of cargo by enabling simultaneously cargo handling. Container trade volumes accounted for approximately 15 per cent of the total trade by sea

measured in volume (tons) (United Nations, 2012). Figure 4 illustrates the development in container trade from 1990 to 2011both in percentage and in volume.

Figure 4: Development of container trade in percentage and volume (United Nations, 2012)



The increase in growth of container trade is due to several reasons (United Nations, 2005):

- *Liberation of international trade and the globalization*
- *Shift away from basic commodities towards processed primary products and manufactured goods*
- *Containerization in combination with the development in information and technologies has expanded the range of trading possibilities*
- *Chinas as an emerging container market.*

Container transport by sea is mainly done by specialized purpose-built vessels, constructed to carry containers. Since the entrance of containerization (United Nations, 2012) there has been an increase in vessel size and the total fleet of container vessels has grown approximately seven times. Today the largest vessels can carry up to 15 500 TEUs, e.g. the Emma Maersk class of Maersk. This is because shipping companies wants to achieve economies of scale by lowering the cost per TEU mile. Notteboom (2004) discuss the negative factors of introducing "mega ships" in the container market reasoning the following factors;

- *Shipping lines have made huge investments in establishing competitive networks to satisfy global requirements of the shippers, such as weekly departure at each port of call.*
- *The economic and operational considerations will act as the ultimate barrier on super large vessels sizes and design of the future. The large vessels will have constraints on ports available to call, and be less flexible than smaller vessels.*

- *The ultra large vessel can be developed efficiently in the major trade lanes, provided high utilization of slot capacity.*

Today the containerization is implemented globally and the network of ports which handle over 34 000 TEUs a year are over three hundred, and these ports generates over 100 000 possible routes.

1.2.2 Container trade flows

The shipping of containers can be divided into three main trade groups (United Nations, 2005). The first is the East-West trades. These routes circle the globe in the northern hemisphere and are the link between the major industrial areas of North America, Europe and Asia. The three main East-West trade routes are (United Nations 2012) the Pacific route, the Asia-Europe route and the Transatlantic route. The second, North-South trades, are routes going from the major consumption and production centers. These routes are linking the economic centers of production and consumption with developing countries in the Southern Hemisphere. The two first are inter-regional, served by deep-sea services, while the third group is the routes that are intra-regional. These routes are smaller vessel transporting intra-regional cargo back and forth on shorter distances e.g. feeder and short-sea services. Figure 5 illustrates international shipping lines and the top 20 container ports.

Figure 5: International shipping routes and top 20 container ports (TEUs) (Mangan, 2012)

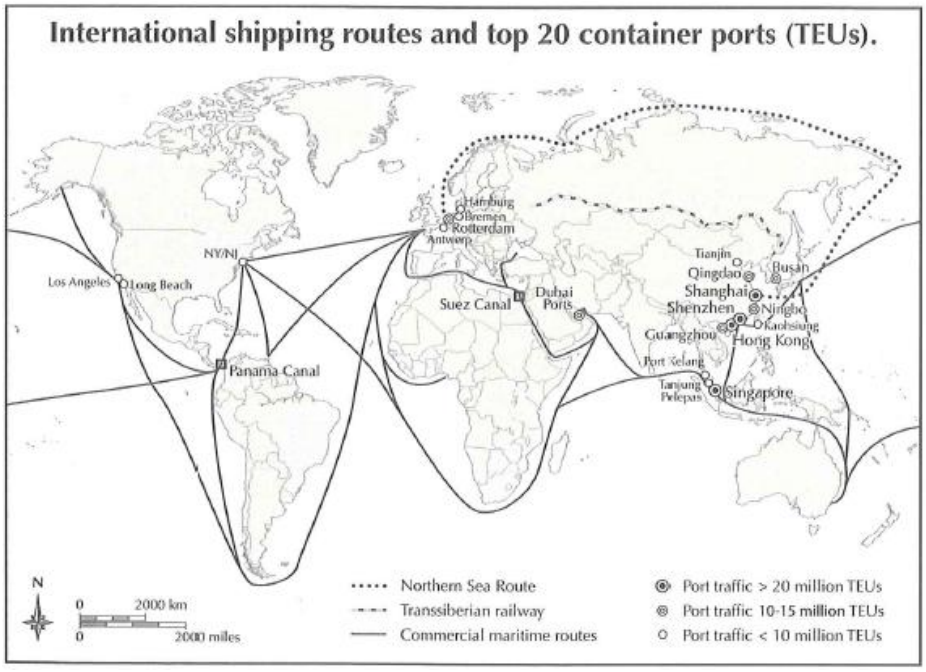


Table 1 shows the 20 main container trade routes in 2009 measured in TEUs handled.

Table 1: 20 main container trade routes in 2009 (World Shipping Council, 2010)

Trade routes	TEUS (Millions)	% Share
Greater China - United States	7,1	7.8%
Greater China - European Union	5,8	6.5%
Other Asia - Other Asia	5,2	4.0%
Greater China - Other Asia	4,6	4.0%
Other Asia - European Union	3,6	3.8%
United States Greater China	3,2	3.2%
European Union - Middle East & Africa	3,2	2.9%
European Union - Other Asia	3	2.8%
European Union - Greater China	2,9	2.7%
Greater China - Middle East & Africa	2,7	2.6%
Other Asia - Greater China	2,7	2.4%
Greater China - Greater China	2,6	2.4%
Other Asia - United States	2,3	2.2%
Latin America & Caribbean - United States	2,2	2.2%
Greater China - Japan	2,1	2.2%
Other Asia - Middle East & Africa	1,9	2.1%
Greater China - Other Europe	1,8	2.0%
European Union - United States	1,8	2.0%
Middle East & Africa - European Union	1,7	1.9%
United States - Other Asia	1,7	1.9%
Rest of World - Rest of World	41,8	38.4%
TOTAL	**103,8**	**100.0%**
Note: TEUs are fully loaded		

The main routes are, as describes above, West-East trades, e.g. Greater China – United States and Europe Union. Other Asia – Other Asia and Other Asia – China are intra-regional trade routes. European Union – Middle East & Africa are North South trade routes.

1.3 Shipping lines

Shipping lines are companies operating vessels that follow a specific route, either port to port or to a series of ports. Container lines operate on a scheduled service where vessels sail on predetermined dates and times – regardless whether they are fully loaded or not. The freight rate of shipping cargo on a line follows a fixed freight rate for each container, regardless of the content in the container or the value of the content. Liners operate on basis of offering a service to shippers that operates with high speed and regularity. The shipping lines operates as an independent line, who can set its own freight rates, or as a conference line (Muthiah, 2010). *United Nations Conference on Trade and Development* (UNCTAD) has defined Liner Conference in chapter one of "*Codes of Conduct for Liner Conferences*" as:

> "*A group of two or more vessel-operating carriers which provides international liner services for the carriage of cargo on a particular route or routes within a specific geographical limits and which has an agreement or arrangement, whatever its nature, within the framework of which they operate under uniform or common freight rates and any other agreed conditions with respect to the provision of liner services."*

Here the involved shipping lines discuss freight rates and shipping conditions for a given trade route or routes. On agreement in a conference the shipping lines agree on the rules of operation and they charge the same rates for the given route (Brooks, 2000), e.g. the *Far Eastern Freight Conference* or the *Europe Canary Islands Conference*. This arrangement retains a "monopoly" on the involved route.

A liner services which are operated by several companies are called an alliance or consortium, e.g. the new alliance *A6*, a new alliance after a merger of the Grand Alliance and the New World Alliance. This alliance will contain the liners` Hapag-Lloyd, NYK line, OOCL, Neptun Orient Lines, Hyundai Merchant Marine and Mitsui OSK Lines and will offer a joint service on the Asia – Europe route.

Negative market conditions can be seen as a reason for having forced shipping lines to diversification its services in order to maintain or capturing market shares (United Nations, 2005). There has been a decline in the conference liner network and there has been introduced a new type of liner operations which focuses on door to door transit, directly from the shippers to the consumers, which embraces multimodal transportation (Branch, 2007). This established intermodal services, develops other elements of the logistical chain

and change from competing on low cost over to competing on a total logistical service. These companies offer a fully integrated multimodal container logistics service, e.g. Samskip, Eimskip and MacAndrews.

According to Lorange (2005) shipping lines operates in fierce competition with each other and the industry is characterized by high capital cost, long ship life and efficient operators, where the service quality is important. The industry is characterized by liner companies influenced to operate on efficiency and productivity with a focus on winning or defending market shares. The gain from achievement in efficiency are often turned over to the costumers to protect own market shares.

Marcus (2003) distinguishes between three tiers/levels of liner companies. Tier 1 is operators that wish to be the industry leader. These companies offer a differentiated product on the basis on price and/or offering a fully integrated service consisting of container vessels, modern terminals, worldwide information systems and a number of added value-creating possibilities through warehousing and trucking.

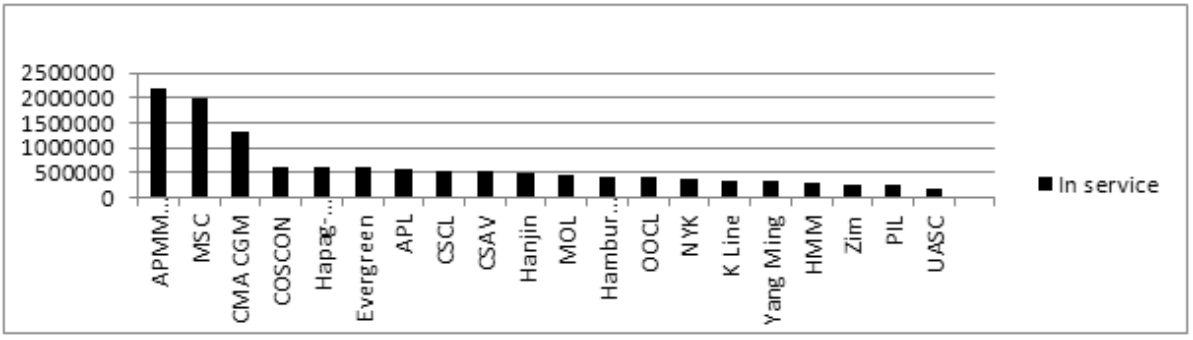
The second tier is carriers that operate on the mercy of the market. These companies play the mass market focus and are characterized by operating with limited resources, suboptimal vessels and restricted inland services.

Shipping lines operating in tier 3 are line operators who are focusing on narrower market segments/niches. These operators often have a close relationship with the shippers and offer specialized vessel which are tailored to this market or niches requirements. Therefore these carriers normally operate in "isolated" geographical locations.

Branch (2007, pp. 51) describes the modern liner cargo services as "*multi-modal and very sophisticated in terms of its logistics and computerized operations"* and "*such companies are continuously striving to improve efficiency and transit times thereby stimulating trade development and improvement of market share"*. These companies follow a business strategy to offer a total transportation service.

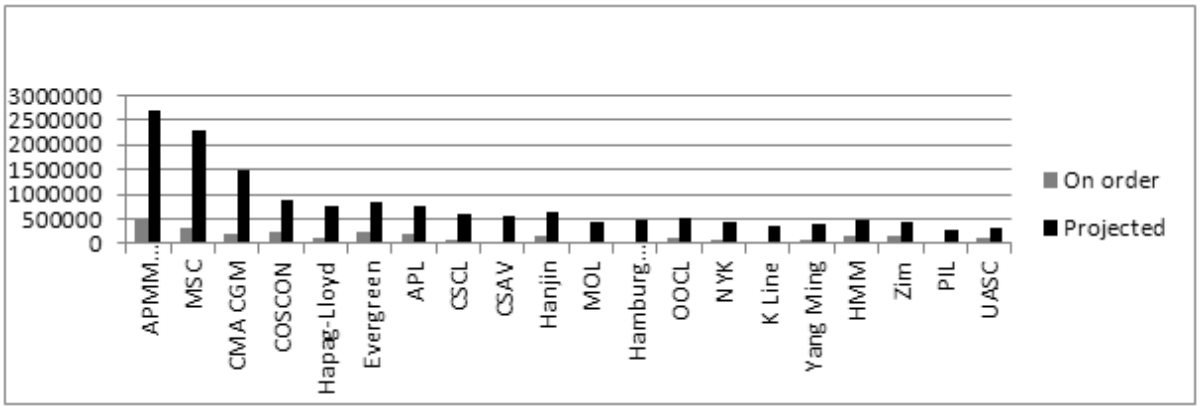
The total operated fleet of shipping lines in 2010 have a capacity of 17 354 726 TEUs divided on 10 101 vessels. Figure 6 shows the distribution of the capacity of TEUs of the twenty largest shipping lines (Containerization, 2011).

Figure 6: Existing container fleet (TEUs) (Containerisation, 2011)



The carriers have a large number of vessels on order and projected (figure 7). This sums up to 26 449 712 TEUs, which compared to todays fleet is higher than the existing fleet.

Figure 7: Container vessel on order and projected (TEUs)



The liner companies usually have a mix of owned and chartered-in vessels, e.g. CMA CGM`s fleet have a mix of 33 per cent owned and 67 per cent chartered-in vessels, and APL have a mix of 29 per cent owned and 71 per cent chartered-in vessels in 2009. The average of the twenty largest container lines were at 51.5 per cent owned and 48.5 per cent chartered-in in 2009 (United Nations, 2012).

1.3.1 Liner services

There exist different types of liner services constructed to serve the demand in the different types of routes. The services are constructed to be profitable for the operators of the line and attractive for its customers. The intricacy of container shipping services has led to a

raise of a hierarchal set of shipping networks. These networks follow a hub and spoke system, just like the port system as described earlier. The inter-regional services transport cargo back and forth between regions and are characterized by calling fewer ports and being operated by larger vessels (Lun et al., 2010). This *deep sea* service will for the rest of this paper will be called inter-regional services. The transport within regions will be addressed as intra-regional services.

The intra-regional, on the other hand are influenced by shorter distances, and smaller vessel. It exist two types of intra-regional services, feeder and short sea. The feeder operations are liners operating a transshipment service, within the hubs and between the smaller ports of the region.

There exist many definitions of short sea shipping and there is still no definition that prevails. The European Commission has defined short sea shipping as:

> "*the movement of cargo and passengers by sea between ports situated in geographical Europe or between those ports and port situated in non-European countries having a coastline on the enclosed seas bordering Europe."* (Brooks and Frost, 2004)

Paixão and Marlow discuss short-sea shipping in their article *Strength and weaknesses of short-sea shipping* (2002). They conclude that the;

> *"Short-sea shipping is a complex maritime transport service, delivered by different channel intermediaries and performed by five ships types capable of carrying unitized and non-unitized cargo within the geographical boundaries which reflects the unification of three different sub-sectors into a broader one where opportunities do arise to provide new market offerings."*

The short-sea operators MacAndrews and Samskip offer a total logistics service with a door-to-door transportation product.

1.4 Research questions

The study has two research questions to examine through statistics analysis. The questions are investigating port selection criteria and the efficiency of the case ports.

The research questions of "An analysis of Shipping Lines` selection criteria when choosing European Container Terminals" are:

Research question 1:

- ***What are the main attributes/most crucial attributes of a European Container Hub, considered by container shipping lines, when selecting European Container Hubs to call?***

Research question 2:

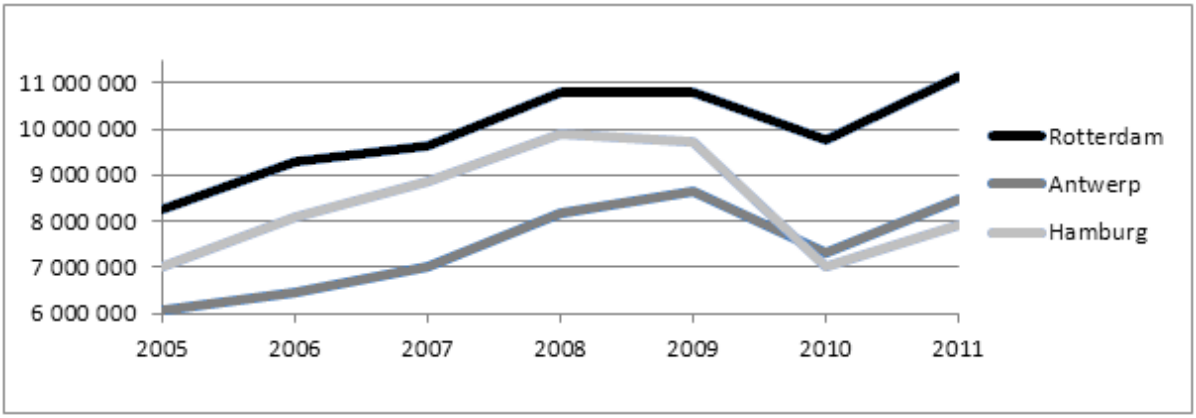
- ***Whether total stay of vessels at berth i.e. (efficiency of port) is affected by the following variables or not:***
  - ***Total numbers of TEU***
  - ***Type of vessel***
- ***In other words, research question two will check the efficiency of ports with the help of linear regression.***

2.0 Ports used as case studies

The ports chosen as case study are chosen on the basis of their size and their role as container distribution centers for the European market. These ports are the Port of Rotterdam, Port of Antwerp and Port of Hamburg as mentioned above.

Figure 8 present the number of TEU transported through the three ports and the development since 2005. The Port of Rotterdam is the leading container port in Europe measured in number of TEUs transported through the port per year (in 2010 in thousands) with 11,140 followed by Antwerp with 8,470 and Hamburg with 7,910 (Containerisation International, 2012).

Figure 8: Container trade volume case ports (Containerisation, 2012)



The next three sub-chapters will briefly go through the three ports and provide an overview of them.

2.1 Rotterdam

The Port of Rotterdam is the leading container hub in Europa and the largest port in Europe. The port is located in the city of Rotterdam, South Holland in Netherland. It was earlier the busiest port in the world, but has been passed by large ports in Asia, e.g. Shanghai and Singapore. In 2011 it was the 10th largest container port in the world and the largest in the European market (Containerisation International, 2012).

The port is operated by the Port of Rotterdam (Port authority) and has since 2004 been owned by the municipality of Rotterdam and the Dutch State, originally it was a municipal body of the municipality of Rotterdam. The port authority aims to enhance the ports

position as a logistics hub and a world-class industrial complex. The Port Authority of Rotterdam operates and develops the port and its industrial area. The authority invests in the development of the port. This includes existing and new port areas, public infrastructure and cargo handling equipment. This is to increase the ports competitive edge (Port of Rotterdam, 2012)[1].

The port authority leases out port areas on long term contract to logistical firms and cargo terminals operator. The port authority main sources of income are through rents and harbor dues and the port authority employees 1,239 people (Port of Rotterdam, 2012)[1].

The ports location makes it one of the main Distribution Centers in Europe. The port serves a hinterland of more than 150 consumers with a combined buying power of $ 600 billion. The port serves this market with a multimodal mix of transportation methods. This includes road, rail, inland shipping, coastal shipping and pipeline. Its unrestricted location allows 24 hours operation 7 days a week (Port of Rotterdam, 2012)[2].

The port consists of several terminals serving different port users and different purpose. The list below shows the different terminals in the Port of Rotterdam that can handle containers (Containerisation International, 2012):

- APM Terminals Rotterdam
- Barge Center Waalhaven
- Barge Terminal Waalhaven
- ECT City Terminal
- ECT Delta Barge Feeder Terminal
- ECT Delta Terminal
- ECT Euromax Terminal
- Hanno Terminal
- HT Holland Terminal
- P&O Ferries Terminal
- Rotterdam Short Sea Terminals
- Uniport Multipurpose Terminals
- United Waalhaven Terminals

These terminals make up the Port of Rotterdam. Together these terminals in 2010 landed 4,706,105 full TEUs and 984,337 empty TEUs and shipped 4,187,632 full TEUs and

[1] http://www.portofrotterdam.com/en/Port-authority/our-company/Pages/default.aspx (Accessed 13 February 2012)
[2] http://www.portofrotterdam.com/en/Port/port-in-general/Pages/hinterland-connections.aspx (Accessed 13 February 2012)

shipped 1,267,730 empty TEUs. This sum up to a total of 11,140,000 TEUs (Containerisation International, 2012).

The port started in 2008 the building of the new port site Maasvlakte 2. This is a direct extension of Maasvlakte. The new area will provide 1000 hectares available for deep-sea operations and it will be able to moor ULCC (Ultra Large Container Carriers) vessels at a 24 hour operating service. These vessels, E.g. Emma Maersk, are able to carry over 10 000 TEUs. The building of Maasvlakte 2 is important for the Port of Rotterdam's ability to grown. According to the port authorities the port will reach its capacity in 2013 – and an extension of the port is essential for an increase in capacity (Port of Rotterdam, 2012)[3].

2.2 Antwerp

The Port of Antwerp the second largest container port in Europe and is based on the coast of Belgium at the city of Antwerp. It has with its position in the North-West Europe and with its hinterland connection become an important link in the chain of international trade. In 2010 it was the second largest port in Europe measure in number in TEUs handled with 8 470 000 TEUs. The port has the largest port area in the world with over 13 000 hectares (Port of Antwerp, 2012)[4].

As Rotterdam, Antwerp with its location, has competitive advantages with its closeness to European consumers. The location of the port lies 80 kilometers up the river from the sea, this allows sea-going vessel to penetrate further into the European mainland. The port offers a direct transportation to over 500 destinations, of these 300 are called every week (Port of Antwerp, 2012)[5].

This lays the foundation for efficient transportation of cargo and the port offers transportation to hinterland by road, rail, barges and pipeline. The port is connected to the river Rhine and Seine through connections from the river Scheldt. The river connections from Antwerp offers inland sea transportation to several countries outside Belgium, this

[3] http://www.portofrotterdam.com/en/Port/port-in-general/Pages/maasvlakte-2.aspx (Accessed 13 February 2012)

[4] http://www.portofantwerp.com/en/port-area (Accessed 13 February 2012)

[5] http://www.portofantwerp.com/en/antwerps-success (Accessed 13 February 2012)

includes Netherlands, Germany, Austria, Switzerland and France. The port has large rail network and all terminals are connected. The rail network distributes cargo to 70 destinations in 19 countries every week. The port is constantly accessible and operates 24 hours a day every day of the week (Port of Antwerp, 2012)[6].

In 2010 the hinterland transportation of seaborne trade is divided in the following transportation modes (Port of Antwerp, 2012)[6]:

- Barges 37%
- Road transport 47%
- Pipeline 5%
- Rail transport 11%

The Antwerp Port Authority is an independent municipally-owned company and acts as landlord. It aims to develop the port infrastructure and maintain the ports competitive advantages. The port authorities also aim to increase the added value the port provides the region and has the responsibility for operational tasks like tugging and dredging and so forth (Port of Antwerp, 2011)[7].

The port consists of several terminals serving different port users and different purpose. The list below shows the different terminals which handle containers at the Port of Antwerp:

- Antwerp Gateway Deurganck Dock Berth
- Churchill Terminal Berth
- Dalwaide Dock Berth
- Deurganck Terminal
- Europa Terminal
- MSC Home Terminal
- Noordzee Terminal
- Vrasene Dock

These terminals make up the Port of Antwerp and handle a total of numbers TEUs in 2011 at 8,470,000 TEUs (Containerisation International, 2012).

[6] http://www.portofantwerp.com/en/transport-and-port (Accessed 13 February 2012)

[7] http://www.portofantwerp.com/en/about-antwerp-port-authority (Accessed 13 February 2012)

2.3 Hamburg

The Port of Hamburg is the third largest container port measured in the number of TEUs handled in 2011. The Port of Hamburg or Hafen Hamburg as it is called in Germany, lies on the river Elbe. More precisely 110 kilometers from the river mouth where the river runs out into the North Sea. The port is called Germanys "Gateway to world" and is together with the smaller port Bremerhaven (handles 4,890,000 TEUs in 2010) the main ports for container trade in Germany (Containerisation International, 2012).

The branching of the Elbe has given Hamburg a natural advantage. The inland waterways have made Hamburg the important logistical hub as it is today. The location between the North Sea and the Baltic Sea, together with the connection between them and including the Kiel Canal connects the port to Scandinavia and the countries surrounding the Baltic Sea (Port of Hamburg, 2012)[8].

As for Antwerp and Rotterdam, its location provides a foundation for efficient transportation of cargo. In 2010 there was more than hundred operating shipping lines going out from Hamburg and to around seven hundred different ports. The port has the highest frequency of departures for feeder services in Europe and offered in 2010 over an average of 150 weekly feeder departures (Port of Hamburg, 2012)[9].

The port had weekly in 2010 seven direct liner services to North America, eleven lines bound to South America, and on average 27 services arriving from the Far East which are the main trade region for Port of Hamburg, in addition to the large network of feeders lines flourishing from the port. 25 percentage of the cargo volume is due to the greater Hamburg area – which is a high proportion of local cargo (Port of Hamburg, 2012)[10].

The hinterland transportation of containers can be shipped out with several different means of transportation; port users can chose between rail, road and inland waterways. The port has 375 kilometers of railroad tracks that ensure the efficiency of the transshipment of

[8] http://www.portofhamburg.com/en/list/maritime-hamburg (Accessed 13 February 2012)

[9] http://www.portofhamburg.com/en/list/Feederverkehre (Accessed 13 February 2012)

[10] http://www.portofhamburg.com/en/content/hamburg-%E2%80%93-universal-port (Accessed 13 February 2012)

cargo by rail. The railway network is as for the Port of Rotterdam and Antwerp connected with most of Europe. The port users can choose from more than ninety different rail companies who provide connections to the hinterland. The transportation of containers by trucks are the most important of the local hinterland transportation less than 150 kilometers. The large network of inland waterways with high capacity lays the foundation for cheap and reliable transportation on barges (Port of Hamburg, 2012)[11, 12 & 13].

The Hamburg Port Authority is a German public service institution and is responsible for the maintenance and development of the port infrastructure. The port authority employs over 1900 people. The authority is in charge of the waterside and landside infrastructure, the shipping safety, in-port railways, the management of real estate and the business environment. The harbor area covers an area of about 7,250 hectares and is a vital part of the economy of Hamburg and the port employs directly 40 thousand people in and around the port (Port of Hamburg, 2012)[14 & 15].

The port consists of several terminals serving different port users and different purpose. The list below shows the different terminals which handle containers and makes up the Port of Hamburg:

- Buss Hansa Terminal
  Container-Terminal Altewerder
- Eurogate Container Terminal
- HHLA Container Terminal Burchardkai
- HHLA Container Terminal Tollerort
- Leercontainer Zentrum Unikai
- O`Swaldkai Terminal

These terminals sums up the total number of container handled by the Port of Hamburg, which were in 2011, 7 910 000 TEUs (Containerisation International, 2012).

[11] http://www.portofhamburg.com/en/list/Bahnverkehre (Accessed 13 February 2012)

[12] http://www.portofhamburg.com/en/list/LKW-Verkehre (Accessed 13 February 2012))

[13] http://www.portofhamburg.com/en/list/Binnenschifffahrt (Accessed 13 February 2012)

[14] http://www.portofhamburg.com/en/content/hamburg-port-authority(Accessed 13 February 2012)

[15] http://www.portofhamburg.com/en/content/geographic-position (Accessed 13 February 2012)

2.4 Other regional competitors not used in this study

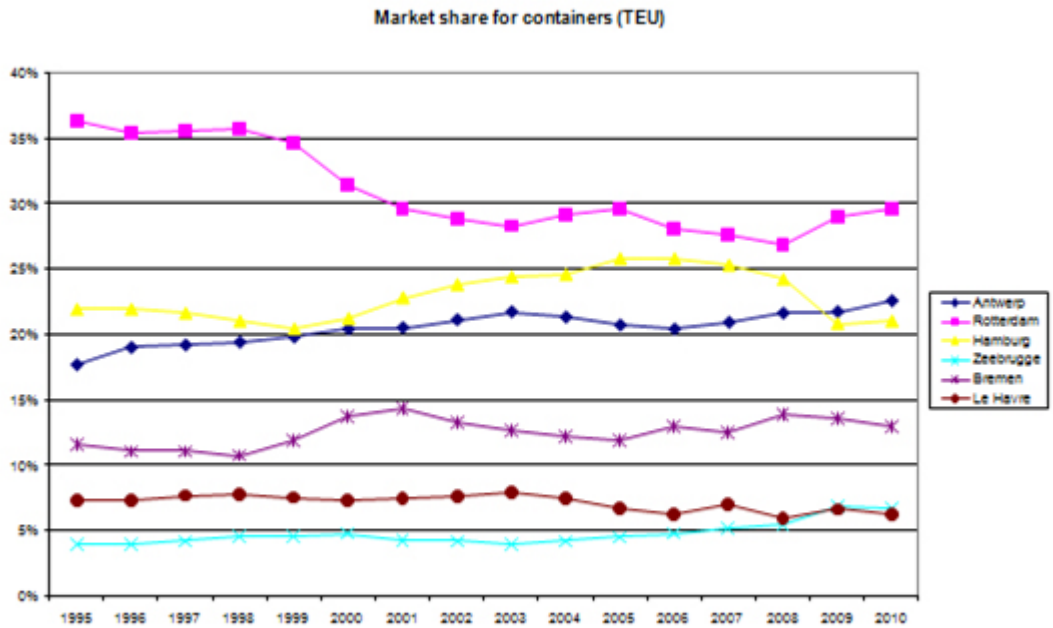
The other possible competitors for market shares, as a Distribution Center for the European market, are taken from the list of the leading container ports of the world measured in the number of TEUs handled in year. The next ports in 2010 coming after the Port of Rotterdam (11,115,804 TEUs), the Port of Antwerp (8,468,475 TEUs) and the Port of Hamburg (7,900,000 TEUs) are:

- Bremerhaven (4,871,297 TEUs)
- Valencia (4,206,937 TEUs)
- Felixstowe (3,400,000 TEUs)
- Gioia Tauro (2,851,261 TEUs)
- Algericas (2,810,242 TEUs)
- Zeebrugge (2,389,879 TEUs)
- Le Havre (2,358,077 TEUs)

These ports are the main competitors for market shares as distribution centers. Numbers are taken from the Containerisation Internationals *Containerisation International Yearbook 2011* from 2012.

As for the ports located along the coast of Western Europe against the North Sea and the English Canal the distribution of market share is displayed in figure 9 issued by the Port of Antwerp.

Figure 9: Market share for Container Hamburg - Le Havre range (Port of Antwerp, 2011)



This graph shows the development in the distribution of the market share between the case ports and Zeebrugge, Bremen/Bremerhaven and Le Havre. It displays that the Port of Rotterdam had a decrease from 1995 to 2010 with around 7 percentages while Port of Antwerp has grown around 6 percentages. The Port of Hamburg has increased and then decrease in this period and has around the same level of market share.

3.0 Theoretical framework

This chapter reviews the theory used to construct the questionnaire. Prior research on "Port optimization" in respect to port selection criteria is presented. This chapter will give a description of the attributes of a port affecting port selection found in the presented articles. This will be presented in two chapters; First a literature review on port selection criteria and secondly definition of the different attributes of attractiveness examined in this thesis.

3.1 Port selection criteria

As describe in chapter one, ports compete for the market share and have to offer a service that meets the customers' requirements. The attributes or characteristics of a port influence their attractiveness. The prior research on port selection criteria has found a lot of attributes which are influential when shippers and shipping companies choose ports of call. Kreukels and Wever (1998) states in their book *North Sea Ports in Transition: Chaining tides* the port selection depends upon many factors and that shipping companies must take the following points into consideration when choosing ports:

- The ports accessibility
- The accessibility to the hinterland
- The location of the clients and the shipping companies
- Cost of calling the port
- The competitive environment at the port
- Quality of physical infrastructure and equipment at the port
- Customs efficiency and flexibility

Lun et al. (2010) describe the following factors as important when carriers are developing basic strategies in their book *Shipping and Logistics Management*:

- The amount of profitable cargo that can be generated
- The existence of feeder networks affecting the flexibility of the cargo transshipments arraignment to minimize ship turnaround time.
- To facilitate rapid cargo transshipment, the port authority, shippers, agents, customs, trade association and inland transport operators should be taken into considerations
- The berth layout and other facilities, e.g. stacking area at container yards and container handling equipment.
- The port should operate 24h a day seven days a week to shorten vessel berthing time
- The efficiency of port operations that can improve ship turnaround time and overall cargo transit time
- A good intermodal network, where terminals are designed for ease of intermodal transfer to and from road, rail, and inland waterway transport.

- The port should be strategically located on a major shipping lane and should be supported by a strong hinterland.
- The availability of bunker and ship repair facilities in the port and their charges must be considered.
- Modern ports are fully computerized in all the areas of terminal operations. The adoption of technology is essential to reduce the turnaround time of the vessels
- Port competitiveness in terms of cost is also important. Terminal handling charges, storage charges and availability of free time at terminals are key determinants

The amount of profitable cargo that can be generated reflects the potential for the profitability if choosing to call the port. The book states the efficiency of the port are of key importance, this because inefficiency increases the transportation cost in the supply chain.

The article *A disaggregate analysis of port selection* by Malchow and Kanafani (2003) investigated port selection factors, port competition and port strategies. The authors applied an alternative form of the discrete choice model to analyze the distribution of the maritime shipments among US ports. The article concludes that the choice behavior differs between carriers and between commodities. The model defines efficiency as dependent on transit time and cost. The four factors effecting time is defined as the distance from origin to the port, the time needed to transfer the shipment from the ground to the vessel, the time incurred as the vessel calls at other ports in transit and the oceanic distance from the port to the shipments distance. The four factors influencing the operating cost is defined as the inland distance from the origin to the port, the charges assessed by the port, the oceanic distance from the port to the destination of the shipment and the average vessel size representing economies-of-scale and density (Malchow and Kanafani, 2003).

Tongzon (2007) analyzed port selection criteria and port performance. The article is based on a survey of shippers located in one of the centers of port competition in Asia. The analysis used is basic econometrics. The result of the article found the port efficiency, shipping frequency, infrastructure, location, handling charges, responsiveness to customer needs and reputation, as important attributes affecting port selection.

In 2008 Chang et al. conducted a survey on port selection by shipping lines. This resulted in the article *Different perspectives between trunk liners and feeder service providers*. The survey resulted in six factors affecting shipping lines choice of port:

- local cargo volume
- handling charge
- berth availability
- port location
- transshipment volume
- feeder network

The PHD thesis "*Competition and Cooperation among Container Terminals in Pakistan: with Emphasis on Game Theoretical Analysis*" by Saeed (2009), examined selection criteria applied by carriers when choosing container terminals in two Pakistani ports through distributing a survey and statistical analysis. Her literature review found nineteen attributes:

- Number of ships visited
- Total number of TEU contained in a vessel
- Loading/discharging rate per hour
- Freight charges
- Number of berths
- Number of gantry cranes
- Total stay at berth
- Container inquiry
- Frequency of cargo loss and damage
- Equipment availability
- Convenience for pick-up and delivery
- Storage facilities
- Ability to handle large volume of cargo
- Night navigation
- Switching cost
- Asset specification
- Personal contacts
- Private/public terminal
- Location

The article *A New Approach to Port Choice Modeling* by Magala and Sammons (2008), referred to earlier in chapter one, states that the port selection has moved from being solely done by a shipper over to a choice of supply chain where the quality and reliability is important selection criteria.

In the book *The geography of transport systems* Rodrigue et al. (2009) state the location, accessibility and infrastructure as the most important attributes of a container port.

Tongzon (2009) empirically examined port choice behavior of a sample of freight forwarders in Southeast Asia. This investigation found that port efficiency, connectivity to other ports and adequate infrastructure as the important selection criteria.

Tran (2011) studied port selection on liner routes from a logistics perspective. Tran (2011) viewed the liner shipping as a service of offering transport of cargo to a network of ports and not the traditional port to port operations. The article illustrates the liners routing problems and the dilemma of cost efficiency versus the effect on the costumers` service level. This was presented through a model containing shipment cost, port tariff, inland transportation cost and inventory cost. The article presented a number of attributes, e.g. handling cost, operational expenses, hinterland transportation cost and inventory cost.

The article *Port and terminal selection by deep-sea container operators* by Wiegmans et al. (2008) examined, as the title states, the deep-sea container operators port and terminal selection criteria. The article presents the following factors as choice criteria:

- Port infrastructure
- Location
- Efficiency of the port
- The interconnectivity of the port
- Reliability, capacity frequency of inland transportation services
- Quality and cost of auxiliary services
- Efficiency and cost of port management and administration
- Availability, quality and cost of logistics value added services
- Availability, quality and cost of port community services
- Port security/safety and environmental profile of the port
- Reputation

3.2 Attributes of attractiveness of a port

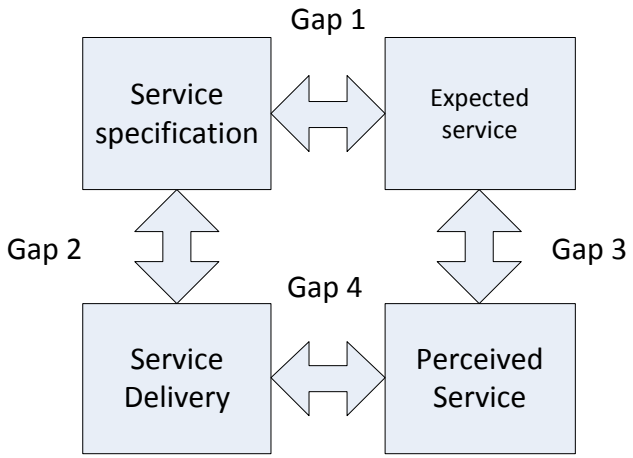
The attributes found from the review of prior research on port selection criteria are the basis for the design of the questionnaire. The following attributes are used to examine the port selection of European Container Terminals:

- Service quality
- Loading/discharging rate
- Handling charges
- Number of TEUs handled at the port
- Number of vessels calling at the port
- Level of congestion at the port
- Location
- Efficiency of the hinterland connections
- Personal contacts
- Logistical services provided at the port
- Storage facilities
- Value-added services provided at the port
- Navigational availability (night navigation)
- Switching cost from one port to another
- Asset specification
- Structure of port authorities and ownership

The next paragraph will briefly go through the different attributes. The author has assumed that adequate infrastructure is satisfied by the three case ports due to their development and their role as regional distribution center. Therefore, this is not tested.

The quality of service concerns the fulfillment of the costumers expected service and delivery without gaps. The quality of service takes place during service delivery, which is the interaction between customer and the service process. According to van Hoek (2008) a difference in service quality arises when there is a difference between the design of the service by the supplier and the customers expected services, a differences between the design of the service and the actual service delivery, when there is a difference between the expected and the perceived service or a difference in how the supplier service deliver and the customer perceived the delivery of the service. This is illustrated in the figure 10.

Figure 10: Service quality and gaps (Hoek, 2008)



The loading and discharging rate is a measure of the efficiency of the port and is linked up to the cost of the operations. Inefficiency generates extra costs. The handling cost influences the profitability of the carriers' port operations. As service quality costs this makes the handling cost an equation of leveling service quality and handling cost.

The switching cost is referred to as the customers' perceived costs of switching from the existing to new port terminal (Saeed, 2009). The asset specification cost is the cost that arises when establishing a new port of call instead of an old one. These costs are investment in specific knowledge, routines, machines, and tools to serve a specific trade partner, and as well the sunk cost left behind by rejecting a prior port of call (Saeed, 2009).

The navigational availability states the carriers' opportunity to call the ports at 24 hours a day, seven days a week. The level of congestion at the port states the importance of the availability to call the port at arrival time and the avoidance of waiting on berth.

The location of the port has to be in a strategic position in relationship to the final destination of the cargo and the relationship the available transportation to the hinterland in order to arrange efficient transportation through the supply chain. The hinterland is the area where the demand for cargo movement is generated (Rushton et al., 2011). The storage facilities are the ports ability to store containers within the port area; this usually takes up around 60 to 70 percentage of the total terminal area. The container storage facilities stakes-up containers awaiting onward movement and are usually linked up to

other transportation modes (Lun et al., 2010). The size of the storage facilities sets the foundation for the capacity of cargo volume.

The traditional logistical services are storage, warehousing and offering of distribution center services. The integrated logistics service includes value-added services; labeling, assembly, repairing, consolidation, packing, economic processing, contingency protection and operation efficiency (Nam and Song, 2011). The value-added service enables ports to add value to the service and facilitate for optimization in the supply chain. Nam and Song (2011) state that the value-added services are of key importance for ports integration in supply chains.

Personal contacts as selection criteria reflect mutual dependencies and loyalty that has arisen through prior operations.

4.0 Research methodology

This chapter will give a description of the research methodology of the thesis. It will describe the design of the research and how the data is collected and analyzed in order to answer the research questions precise and accurate.

The sub-chapters first starts with a review of the research design, secondly a review of the collection data and thirdly the method used to analysis.

4.1 Research design and research framework

This study aims to detect container shipping lines crucial selection criteria of European container terminals. The methodology of the thesis is designed to answer the research questions in chapter 1.4.. Research is defined by Leedy and Ormrod (2010, pp. 2) as: *"a systematic process of collecting, analyzing and interpreting information (data) in order to increase our understanding of the phenomenon about which we are interested or concerned"*. In order to efficiently achieve quality research, the research must be designed in an appropriate way. The research design is therefore an important part of the preliminary work. The research design, defined by Yin (2009, pp. 26**)** as *"a logical plan for getting from here to there, where here may be designed as the initials set of questions to be answered and there is some set of conclusion (answers) about these questions"*. Research design is created to have a thorough plan that ensures the quality of the study process, as well as it facilitates for accurate answers to the research questions. Yin (2009) further describes five steps of research design;

1. A study question
2. Its propositions if any
3. Its unit of analysis
4. The logic linking the data to the propositions
5. The criteria for interpreting the findings

Research can be divided in two types; qualitative or quantitative. Denzin and Lincoln (2005, pp. 3) defines qualitative research as;

> *"a situated activity that locates the observer in the world. It consists of a set of interpretive, material practices that make the world visible. These practices transform the world. They turn the world into a series of representations, including field notes, interviews, conversations and memos to the self. At this level, quality research involves an interpretive, naturalistic approach to the world. This means that qualitative researchers study things in their natural settings, attempting to make sense of, or interpret, phenomena in terms of meanings people bring them"*

The purpose of qualitative research is to achieve a better understanding of a complex situation. Quantitative research is defined by Burns and Groves (2005) as:

> *"a formal, objective, systematic process in which numerical data are used to obtain information about the world."*

The purpose of quantitative research is to establish, confirm or validate relationships and develop generalizations that contribute to the theory.

Ellram (1996) describes that research methodology can be segmented on basis of the type of data that are used and the type of analysis that are applied. Ellram (1996) illustrated this in the figure 11 below:

Figure 11: Type of analysis versus type of data (Ellram, 1996)

Type of data	Type of analysis: Primary quantitative	Type of analysis: Primary qualitative
Empirical	Survey data Secondary data Statistical analysis	Case studies Observations Limited Statistical analysis
Modelling	Simulation Linear programming Mathematical programming Decision analysis	Simulation Role playing

The quantitative methods are described by Andy Field (2009) as *"inferring evidence for a theory through measurement of variable that produce numeric outcomes"* and qualitative methods as "*extrapolating evidence for a theory from what people say or write*".

Ellram (1996) differ the type of data as modeling or empirical and the type of analysis as primary quantitative or primary qualitative. The model above describes the relationship between the type of analysis and the type of data.

This study is an empirical examination of predetermined port users` selection criteria by distributing a questionnaire to a specific segment of the port user The outcome of this study aims to be helpful for terminal operators and port authorities to improved efficiency

and productivity of their port according their costumers` requirements and thus improve their competitive advantages.

This study applies three ports as case study to examine shipping lines port selection criteria and examines the research questions both qualitative and quantitative. Figure 11 above shows the type of date against type of analysis. This study applies limited statistical analysis to analyze port selection criteria in general for container shipping lines. This is an empirical qualitative type of analysis and shows the cross-section of the case studies opinion.

This study also applies a component analysis and linear regression. The factor analysis is an empirical quantitative analysis method to examine if attributes of a port can be portioned into fewer factors. The linear regression in this study builds a model on efficiency and is quantitative method of analysis.

These two methods of analysis are quantitative. The methods of analysis describe here will be reviewed in chapter *2.4 Method of analysis*.

Ellram (1996) illustrates case study to be a qualitative method of analysis. Yin (2009, 18) defines case study as;

> ”*an empirical inquiry that investigate a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident*”.

Creswell (2007) describes case study to be one of five approaches to qualitative research. The four others are; narrative research, phenomenological research, grounded theory and ethnographic research.

The method for primary data collection for this study is survey. Survey is according to Fink (2003) as; *“a system for collecting information from or about people to describe, compare or explain their knowledge, attitude or behavior*”. A case study can be either a single case study or multiple case studies (or collective case study) and involves, according to Creswell (2007) the study of an issue explored through one or more cases within a bounded system.

In Denzin and Lincolns (2005) *Handbook of Quality Research* includes R. E. Stakes statement that case study is not a methodology but a choice of what to be studied.

The construction of the questionnaire and the survey will be reviewed in the subchapter *1.2.1 Primary data*.

This study had a research framework consisting of six hierarchal steps ensuring the quality of the study. These six hierarchal steps are:

1. Map research area
2. Build questionnaire
3. Pilot study
4. Full-scale survey
5. Analysis
6. Thesis write up

The first step was to map the research area and identify different aspects of ports and port players through a brief review of relevant literature. This step was conducted before the writing of proposal for this thesis. The mapping process aimed to provide an overview of the proposed thesis research area and detecting specific areas of scientific interest. In this process the segment of port users, container shipping lines, was selected. Then the segment was further narrowed down to a specific type of ports, Regional Distribution Centers, in a specific market, Europe.

The next step was to conduct a deeper literature review on the narrowly focused area of research before writing the proposal. In this process the Ports of Rotterdam, Antwerp and Hamburg were selected as case ports, and container shipping lines calling these ports was mapped as potential respondents in the survey, as well as research questions were developed. The proposal also included a tentative time-schedule.

After the approval of the proposal, the work of constructing the questionnaire was conducted with an aim of empirical examine container shipping lines choice behavior on European Distribution Centers. The questionnaire was then tested on a predetermined number of randomly chosen container shipping lines in a pilot study. This pilot study was conducted to test the questionnaire for short-comings before the full-scale survey.

The statistical analysis on the response from the survey was conducted after the deadline on the data collection (survey) and aimed to find trends that could provide answers to the research questions.

The final task was to write the dissertation.

4.2 Data collection

The two main types of data are primary and secondary data. Primary data (Walliman, 2001) is "*data gained by direct, detached observation or measurement of phenomena in the real world, undisturbed by any intermediary interpreter"* and secondary data as *"data that have been subjected to interpretation they are referred to"*.

The next two sub-chapters will review primary data and sources for literature review in this study.

4.2.1 Primary data

The primary data in this thesis will be gathered through a survey conducted with shipping lines calling to the selected case ports. The survey uses a questionnaire constructed to detect which attributes of a port that are crucial for its selection when choosing regional distribution center to call through statistical analysis.

The questionnaire is based on prior research on port attractiveness. The prior studies on port attractiveness have found a large number of different attributes of attractiveness. These attributes are displayed in the theoretical framework and is the main secondary data of this thesis.

As defined above by Fink (2003) surveys are a system for collecting data which is used for analysis. Survey design can be divided into experimental design and descriptive design (cross-sectional design). The cross-sectional is a simple survey that provides a cross section of the group's opinion and experimental are characterized by the comparison between two or more groups, at least one of which is experimental (Fink, 2003).

This study is cross-sectional and examines the groups, shipping lines, opinion on port selection.

Fink (2003) states the following characteristics are important for good surveys; specific objective, straight forward questions, sound research design, reliable and valid survey instruments, appropriate management and analysis, accurate reporting of survey results and reasonable resources.

Use of questionnaire to empirical examining port selection criteria is convenient by its ability to be distributed out to a large number of respondents. Leedy and Ormrod (2010) describe the drawback of using questionnaire is usually influenced by a low return rate.
The constructed questionnaire is self-administrated. This is a questionnaire that consists of questions that the individual respondents complete by themselves. The construction of the questionnaire is important for the reliability and validity of this study and the appropriate measurements must be chosen. Validity is defined by Leedy and Ormrod (2010) as *"the extent of the quality of measurement"* and the reliability as *"the consistency with which a measuring instrument yields a certain result when the entity being measured hasn`t changed"*.

The questionnaire (appendix one) consists of two parts, Part A and Part B.

Part A is design to get information about the respondent and information on three cases of port operation made by the shipping line, and rating matrix on port selection criteria. These selection criteria are the one found in the theoretical framework.

Part B consists of questions on the port selected as case study. The respondent here rates the ports used as case studies in terms of the attributes affecting port attractiveness.

The rating matrix question is in Likert Style and the respondents' rate statement in an interval e.g. from one to five, where one represent strongly disagree, five strongly agree and three represent neither agree nor disagree. The Likert scale was developed by Rensis Likert in the 1930s to assess people's attitude towards different statements. This study applies Likert scale in all rating questions.

The questionnaire was distributed to container shipping lines. In order to send the survey to the right person, the companies involved was called first. The "right person" to answer

the survey was person in management with high knowledge of strategy and operations, e.g. CEO, Line Manager, Operation Manager, Logistics Manager, and Business Development Manager. This to ensure an accurate and honest answer by the respondents on the survey.

A "call" sheet was made to ensure the quality of the telephone conversations (appendix two). This call sheet contained all relevant information on the thesis. After getting in touch with the right respondent at the shipping companies, the survey was sent out by mail. This mail also contained brief information on the thesis and a reference letter (appendix three). The respondents choose to answer the survey by paper or electronically. The electronically survey was constructed with the online survey program Questback and distributed through a link by mail.

The distribution of the questionnaire was done in two steps. The first step was distribution to randomly chosen sample of the population of container shipping lines calling the case ports for a pilot study. The pilot study was carried out to test the questionnaire for faults and check the response rate. The pilot study sample consisted of fifteen companies of various sizes and various types of liner operations resulting in eight replies. This gave a response rate at 53,33 %. The result of the pilot study initiated further distribution of the survey to the rest of the container shipping lines calling the case ports. The respondents were found in the mapping process and consisted of a total of seventy two (appendix four).

In the main distribution of the questionnaire eight respondents was found unsuitable for the survey and was excluded. A respondent was found unsuitable if the company did not fit to this study – container shipping line operating lines to and from the ports used as case study, e.g. MISC Berhad, who had exited from the liner business. The respond of rest survey whereas following:

- 27 qualified replies
- 17 respondents was unable to reach
- 11 unwilling to answer
- 17 failed to reply within time

The respondents unable to reach were mainly due to failing to reach the right person at the liner and the unwilling to answer was mainly due to lack of time by the respondent. Due to the time-constraint of this thesis a deadline for the survey was set. 17 companies willing to

contribute failed this deadline and are not included in the statistical analysis. The response rate of the thesis is 37,5 per cent (excluded the unsuitable).

4.2.2 Sources for literature review

The secondary data in this study are mainly articles from scientific databases and literature found at Molde University College Library. The databases used are Taylor and Francis Online and Science Direct and the access to these databases is provided by Molde University College. The theses have used articles from the following Journals:

- Maritime Policy and Management
- Transport Research Part E: Logistics and Transportation Review
- Applied Economics
- Marine Policy
- Journal of Transport Geography
- Economics Geography
- Research in Transport Economics
- Review of Network Economics
- International Journal of Transport Management
- International Journal of Logistics Management
- Computer and Operations Research
- Journal of Business Logistics

The literature used from the library was on the subjects; shipping, ports, logistics, research methodology, supply chain management and international trade.

4.3 Method of analysis

The collected primary data are the basis for the statistical analysis, done through the statistical software program SPSS. The aim of the analysis is to detect and answer the research questions. The analysis process consisted of several steps;

1. Construct a SPSS coding
2. Prepare SPSS for entering of data
3. Enter the collected data
4. ERROR analysis
5. Explore descriptive statistics
6. Conduction of statistical analysis

The coding in SPSS is constructed to the ability to conduct the statistical analyzes that the research questions requires to find trends and valid answers from the collected primary data. Step two is to prepare SPSS for entering the collected data; this includes typing in the parameter accurate according to its specifications. After the completion of the framework in SPSS the collected data is entered and check for error through Error analysis. These

three first steps are the foundation of the conduction of the statistical analyzes. The statistical analysis firstly explores descriptive statistics and secondly statistical analyzes to detect findings that can answers the research questions.

The next three subchapters will briefly go through the methods of analysis used to analyze the research questions.

4.3.1 Research question 1

Research question 1 is examining the attributes of port selection. The first step of the analysis is to explore the mean and standard deviation of the different attributes found in the theoretical framework from the collected data through descriptive statistics.

The next step is to conduct a factor analysis which determines whether the attributes can be reduced into fewer factors. This statistical method examines the inter correlation between the different attributes, and the aim is to reduce the attributes of attractiveness found in the theoretical framework into fewer coherent subscales. Field (2009) defines factor analysis as "*a multivariate technique for identifying whether the correlations between a set of observed variables stem from their relationship to one or more latent variables in the data, each of which takes the form of a linear model"*.

Pallant (2007) describes two types of factor analysis, exploratory and confirmatory. The exploratory approach is used in the early stage of the research to explore interrelationships between the set of variables. The confirmatory approach is a more complexed and sophisticated set of techniques used to test hypothesis or theories.

This study uses the first approach to find interrelationships between the different variables used in the questions in Part B of the questionnaire.

There are three steps of factor analysis:

1. Assessment of the suitability of the data for factor analysis
2. Factor extractions
3. Factor rotation and interpretation

The first step of the factor analysis is to assess whether the data collected is suitable for factor analysis. The assessment of suitability treats the collected datas size and the

relationship between the different attributes. To asses this study the *Kaiser-Meyer-Oklin (KMO) measure of sampling adequacy test* and the *Bartlett`s Test of Sphericity* will be used. KMO must have a value over 0,6 and Bartlett`s test of sphericity must be significant in order to be suitable for factor analysis (Pallant, 2007).

The factor extractions determine the smallest number of factors which can be extracted to best represent the inter-correlation of the data set. The main techniques for factor extraction are principal components, principal factors, image factoring, maximum likelihood factoring, alpha factoring, unweighted least squares and generalized least squares. Principal components analysis is the most common technique and is used in this study, this method is a multivariate technique and identifies the linear components of a set of variables (Field, 2009).

There are a number of techniques to that can be used to assist the decision concerning the number of factors to retain; Kaiser`s criterion, Scree test and Parallel analysis.

The factor rotation and interpretation is the final step. There are two main approaches for rotating the variables which results in uncorrelated or correlated solutions; orthogonal or oblique solutions. The uncorrelated results are easier to interpret and report. This thesis will use the orthogonal technique Varimax to minimize the number of variables which have a high loading on each factor (Field, 2009).

4.3.2 Research question 2

Research question two examines the efficiency of the ports used as case study. In Part A of the questionnaire the respondents are asked to fill in three questions related to port operations. These include information on Total TEU contained in vessel, total time of berth, vessel size and vessel type for the last three vessels called at the three case ports.

The efficiency is examined with the help of linear regression. Regression analysis is a method of predicting a value based from one or more predictor variables (Field, 2009). Regression analysis with one predictor variables is called *simple regression* and regression with several predictor variables is called *multiple regression*. This study will examine the efficiency of the case ports through use of multiple regression. Newbold et al. (2010)

states that "*multiple regression enables us to determine the simultaneous effect of several independent variable on a dependent variables using the least square principle"*.

The regression model is defined by Field (2009) as:

$$Y_i = b_o + b_1 X_{i1} + b_2 X_{i2} + \ldots + b_n X_n + \in_i$$

- Y_i is the predicted value based on the value of $_i$.
- b_0 is the y-intercept
- b_1 is the coefficient of the first predictor, X_1
- b_2 is the coefficient of the first predictor, X_2
- b_n is the coefficient of the first predictor, X_n

There exists three types of multiple regression; standard, hierarchical and stepwise. This study applies standard regression. It means that all the independent variables are entered into the equation simultaneously. The dependent variable in this study is the length of stay at the berth, while the explanatory variables are vessel type and total number of TEU contained in vessel.

5.0 Comparative analysis of Shipping Lines selection criteria on European Container Terminals

The comparative analysis of selection criteria of European Container terminals are analyzed through statistical analysis.

The chapter is divided into sub-chapters which address the two research questions for themselves.

5.1 Research question one

What are the main attributes/most crucial attributes of a European Container Hub, considered by container shipping lines, when these lines select European Container Hubs to call?

5.1.1 Descriptive statistics of attributes for port selection

In Part A of the questionnaire the respondents were asked to rate the importance of different attributes of a port. The respondents could rate the different attributes from not important (one) to very important (five).

The descriptive statistics indicates that Loading/discharging rate and handling charges as the two main selection criteria, influencing ports attractiveness. These two attributes have a mean of 4.62 and a standard deviation of 0.852 and is considered (according to the scale) to be very important.

The next selection criteria of importance are the service quality, navigational availability, level of congestion, efficiency of hinterland transport and location which the respondents reflects as important for port selection. These five attributes was in the interval (by the order) from 4.27 and down to 4.

The results of the descriptive statistics are presented in table 2 on the next page.

Table 2: Descriptive statistics

	Min	Max	Mean	Std. Deviation
Loading/discharging rate	1	5	4,62	0,852
Handling charges	1	5	4,62	0,852
Service quality	2	5	4,27	0,874
Navigational availability	2	5	4,15	0,949
Level of Congestion	1	5	4,12	1,071
Efficiency of hinterland transport	2	5	4,04	1,091
Location	2	5	4	0,784
Switching cost	2	5	3,69	0,884
Investment made by port	1	5	3,67	0,92
Logistical services	1	5	3,5	1,03
Storage facilities	1	5	3,48	1,051
No of TEUS	1	5	3,48	1,159
Value added services	1	5	3,3	0,953
investments made by shipping line	2	5	3,27	0,874
Personal contacts	1	5	3,19	0,981
No of Ships	1	5	2,96	1,06
Public or Private port	1	4	2,7	0,912

The selection criteria of least importance are the public/private port, number of vessel calling the port, personal contacts, investments made by shipping line and value added activities. These attribute where in the interval (by the order) from 2.7 and up to 3.3.

5.1.2 Factor analysis

In Part B, respondents were asked to assess the quality of the various attributes of a port, in light of the ports used as case study. The analysis will follow the steps described in the method of analysis; assessment of the suitability of the data for factor analysis, factor extraction and factor rotation and interpretation.

The collected data is first checked for its suitability for factor analysis. This is done by performing the Keiser-Meyer-Oklin (KMO) test and the Bartlett`s Test of Sphericity. The KMO must have a value over the minimum value of 0.6. The test showed a value of 0.742. The Bartlett`s Test of Sphericity have met the requirement and is significant. The two test of assessment of suitability asses the collected data to statistical significant. The result of these two test states that the collected data can be factor analyzed and the result is displayed in the table 3.

Table 3: Assessment of suitability

Kaiser-Meyer-Olkin Measure of Sampling adequacy	0,754
Bartlett`s Test of Sphericity	
Approximately Chi-Square	283,884
DF	78
Sig.	0,000

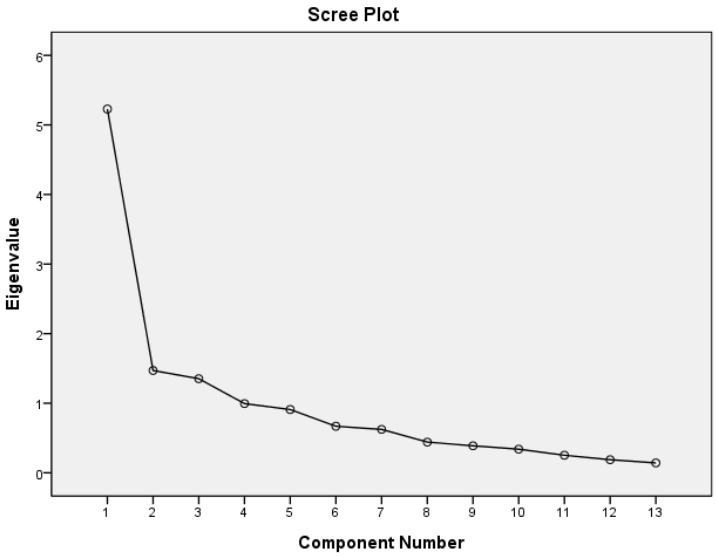
The next step is factor extraction, and the Principal Components Analysis (PCA) shows that four components have an eigenvalue higher than one. The PCA is conducted to find the smallest number of factors that can be used to best represent the interrelation among the set of variables (Pallant, 2007). The result of the PCA is displayed in table 4.

Table 4: Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Component	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5,228	40,215	40,215	5,228	40,215	40,215
2	1,471	11,312	51,527	1,471	11,312	51,527
3	1,352	10,401	61,928	1,352	10,401	61,928
4	,995	7,653	69,581			
5	,909	6,996	76,577			
6	,669	5,150	81,726			
7	,624	4,800	86,526			
8	,442	3,396	89,923			
9	,388	2,985	92,908			
10	,340	2,614	95,522			
11	,252	1,941	97,464			
12	,188	1,444	98,908			
13	,142	1,092	100,000			

To find the right number of components to use is assisted by Catell`s Scree test. This test plots all the eigenvalues found in the PCA test into a scree plot. The “elbow” in the plot best represents the right number of components. The scree plot is shown in the figure 12.

Figure 12: Scree Plot



The number of components which best describes the underlying relationship among the attributes of port selection is 2.

The third step is to perform the factor rotation and interpretation. This involves use of the orthogonal technique Verimax. The results of the Varimax rotation is presented in the Component Matrix (table 5) and Rotated Component Matrix (table 6).

Table 5: Component matrix

	Component	
	1	2
Equipment availability	,785	
Vessel's Stay	,777	
Cargo loss & damage	,765	
Container search	,741	
Storage facilities	,738	
Value added services	,728	
Hinterland Connections	,703	
Asset specification	,693	
Handling rate	,675	
Large Cargo Handling	,486	
Line's investment		
Switching cost		,846
Personal Contacts		-,465

Table 6: Rotated component matrix

	Component	
	1	2
Equipment availability	,778	

Vessel's Stay	,771	
Cargo loss & damage	,767	
Container search	,746	
Storage facilities	,738	
Value added services	,729	
Hinterland Connections	,709	
Asset specification	,689	
Handling rate	,673	
Large Cargo Handling	,493	
Line's investment		
Switching cost		,849
Personal Contacts		-,465

Based on the Verimax rotation we can load 12 variables on to two components. Component 1 contains:

- Equipment availability
- Vessels stay
- Cargo loss & damage
- Storage facilities
- Container search
- Value added services
- Asset specification
- Handling rate
- Hinterland connections
- Large cargo handling

Component 2 contains:

- Switching cost
- Personal contacts

The components have a distinct load of variables. The first component contains "*Ports` specific attributes*" and the second components contains factors regarding "*Formal and informal relationship between port and shipping line"*.

5.2 Research question two

Whether total stay of vessels at berth i.e. (efficiency of port) is affected by the following variables or not:

- *Total numbers of TEU*
- *Type of vessel*

5.2.1 Regression analysis

The regression analysis examines the efficiency of the ports used as case study. The method allows us to check the simultaneous effect of independent variables on the dependent variable. The dependent variable of the model is the total length of stay at berth. The total stay of vessels at berth can be seen as a measure of efficiency. The independent variables are the vessel type and the total number of TEU.

The variable type of vessel regards if the vessel is geared or non-geared and total number of TEUs regards the number of TEUs contained in vessel at berth.

The multiple regression analysis is quite simple and only deal with two independent variables. Other variables gave no significant results.

The regression model is presented in the tables 7, 8 and 9.

Table 7: Model summary

Model	*R*	*R Square*	*Adjusted R Square*	*Std. Error of estimate*
1	0,639	0,409	0,346	8,184

Table 8: ANOVA

Model		*Sum of Squares*	*DF*	*Mean Square*	*F*	*Sign.*
1	Regression	744,400	2	372,200	6,567	0,007
	Residuals	1076,918	19	56,680		
	Total	1821,318	21			

Table 9: Coefficients

Model		*Unstandardized Coefficients*		*Standardized Coefficients*	*t*	*Sig.*
		B	**Std. Error**	**Beta**		
1	(Constant)	24,899	3,122		7,976	,000
	Vessel's type	-10,177	3,843	-,498	-2,648	,016
	Total TEUs	,002	,001	,609	3,240	,004

The model has a value of the coefficient of determination (R squared) at 0,409. This value tells us that 40,9 % of the variation of the dependent variable can be explained by the variation of the independent variables (Table 7).

The negative score (-0.498) states that the type of vessel influences the efficiency at the berth. The non-geared vessel total stay at berth is less than geared vessels. The positive value of the parameter for the variable Total number of TEUs indicates that the more TEUs the longer the stay at berth (Table 9).

6.0 Conclusion

This study has examined port selection criteria when container shipping lines are choosing European container terminals through use of statistical analysis.

The purpose of this study is to detect which port selection criteria are crucial for shipping lines when choosing European container terminals and aims to be useful for port authorities and terminal operators to improve the efficiency and productivity of the port operations according to the customers' (carriers`) requirements.

The introduction tells us that the port compete for market shares and function as economic catalyst in the region they serves. Ports therefore compete against other ports for market shares and have to facilitate its products and services according the customers' requirements.

The study has analyzed data obtained from a survey distributed to container shipping lines. Descriptive statistics of attributes of attractiveness found that loading/discharging rate and handling charges are the most important criteria in port selection. Other important factors are service quality, navigational availability, level of congestion, efficiency of hinterland transport and location. The least important criteria are structure of port authorities and port ownership and number of vessel calling the port.

The analysis found that hinterland connections are more important than the value added activities. This states that ports should focus more on developing good hinterland connections rather than extending the services offered by the port.

Factor analysis is carried out to examine the inter correlation among the different attributes of port attractiveness could be portioned into fewer coherent subscales. The analysis found that twelve attributes can be portioned into two components. Component 1 contains "*Ports` specific attributes*" and, component 2 contains "*Formal and informal relationship between port and shipping line"*.

The attributes of port attractiveness in component 1 are *Equipment availability, Vessels stay, Cargo loss & damage, Storage facilities, Container search, Value added services, Asset specification, Handling rate, Hinterland connections* and *Large cargo handling*. Component 2 contains *Switching cost* and *Personal contacts*.

This study has applied a multiple regression to analyze the port efficiency. This showed that an increase in the number of TEUs increases the total stay at berth and that non-geared vessels have lower total stay at berth than geared vessel.

7.0 Limitations and further research

This chapter will give a description of the limitations of this study and present recommendations and suggestion for further research.

This thesis is limited to a specific transportation segment. The result of this thesis is limited to port selection behavior of container shipping lines calling the main European Container Terminals and therefore port selection behavior in other regions may differ as well as for other container ports within the same region.

This study is conducted from a logistical perspective and the results are thereafter. The terminals of the ports used as case study are treated as one. The individual performance of the terminals is therefore not reflected in this study.

This research presents carriers port selection behavior in this moment of time. The port selection behavior can change as the market further develops. Changes in the market may change the carriers' opinion on the attributes of port selection.

The response on the questionnaire is a sample of the total population of shipping lines calling the three case ports and the opinion of the population may slightly differ from the sample. The results are an indication to which attributes of port attractiveness are crucial for port selection and which are less important.

The study researches port optimization in relation to port selection criteria for shipping lines when choosing European Container Terminals. Recommendation for further research can be to examine the efficiency of the terminals at the main European container hubs.
Further research can follow a similar approach and examine port selection criteria for other regions or other transportation segments and compare it to the situation discovered in this study.

8.0 Reference

Barke, M. 1986 *Transport and trade.* Edinburgh: Oliver & Boyd

Branch, A. E.. 2007. *Elements of Shipping.* London: Routledge

Branch, A. E.. 2007. *Elements of Shipping.* page 51. London: Routledge

Branch, A. E.. 2007. *Elements of Shipping*. page 396. London: Routledge

Branch, A. E.. 2007. *Elements of Shipping*. page 346. London: Routledge

Brooks, M.. 2000. *Sea change in liner shipping: regulation and managerial decision-making in a global industry*. Amsterdam: Pergamon

Brooks M. and J. Frost. 2004. Short sea shipping: a Canadian perspective. *Maritime Policy and management*. 31 (4): 393-407. Available from Taylor and Francis Online (Accessed 23 April 2012)

Burns N. and Grove S.K. 2005. *The Practice of Nursing Research: Conduct, Critique, and Utilization*. St. Louis: Elsevier Saunders

Chang, Y.-T., S.-Y. Lee and J. L. Tongzon. 2008. Port selection factors by shipping lines: Different perspectives between trunk liners and feeder service providers. *Marine Policy.* 32 (6): 877-885. Available from Science Direct (Accessed 30 November 2010)

Containerisation International. 2012. *Containerisation International Yearbook 2011.* London: Informa UK

Creswell, J. W.. 2007. *Quality inquiry and research design*. London: Sage Publications Ltd.

David, P. and Stewart, R.. 2008. *International Logistics, The Management of International Operations*. Mason: Cengage Learning

David, P. and Stewart, R. 2008. *International Logistics, The Management of International Operations*. page 21. Mason: Cengage Learning

Denzin, N. K. and Y. S. Lincolns. 2005. *The Sage Handbook of Qualitative Research*. 3. Thousand Oaks, California: Sage

Ellram, Lisa M.. 2009. The use of the case study method in logistics research, *Journal of Business Logistics*. 17 (2): 93-138. Available from: Emerald (Accessed 25 March 2012)

Field, A. 2009. *Discovering Statistics using SPSS*. London. Sage Publication Ltd.

Goss, R.. 1990. Economic policies and seaports: 4 strategies for port authorities, *Maritime Policy and Management*. 17 (4). 273-87. Available from Taylor and Francis Online (Accessed 4 April 2012)

Hall, P., R. J. McCalla. C. Comtois, B. Slack. 2011. Integrating seaports and corridors. Farnham, Surrey: Ashgate

Hall, P. , R. J. McCalla. C. Comtois, B. Slack. 2011. Integrating seaports and corridors, page 83. Farnham, Surrey: Ashgate

Hayuth, Y. 1981. Containerization and the load center concept, *Economic Geography*, 57(2), 160-176.

Huybrechts, M., H. Meersman., E. Van de Voorde, E. Van Hooydunk A. Verbeke and W. Winkelmans. 2002. *Port competitiveness: An economic and legal analysis of the factors determining the competiveness of seaports*. page 10-13. Antwerp: De Boeck Limited. Available from WorldCat: http://www.worldcat.org/

Kreukels, T. and E. Wever. 1998. *North Sea Ports in Trancition: Chaining tides*. Assen Gorcum & Comp

Lam, J., S. Lee and W. Y. Yap. 2011. Dynamics of liner shipping network and port connectivity in supply chain systems: analysis on East Asia. *Journal of Transport Geography*. 19 (6): 1272–1281.Available from Science Direct (Accessed

2 April 2012)
Lee, T-W and K. Cullinane. 2005. *World shipping and port development*, Basingstoke: Palgrave Macmillan
Lee, Y. and N-Y Hsu. 2007. An optimization model for the container pre-marshaling problem. *Computer and Operations research*, 34 (11), 3295-3313. Available from Science direct (Accessed 25 March)
Leedy, P. D. and J. E. Ormrod. 2010. *Practical research: planning and design*. Boston: Pearson Educational International
Lorange, P. 2005. *Shipping company strategies: global management under turbulent conditions.* Bingley: Emerald
Lun, Y.H.V., K.-H. Lai and T.C.E. Cheng. 2010. *Shipping and logistics Management*. London: Springer
Lun, Y.H.V., K.-H. Lai and T.C.E. Cheng. 2010. *Shipping and logistics Management*. page 51. London: Springer
Magala, M. and A. Sammons. 2008. A New Approach to Port Choice Modelling. *Maritime Economics and Logistics 2008*. 10: 9-26.Available from Palgrave McMillan (Accessed 20 November 2011)
Malchow, M. B. and A. Kanafani. 2003. A disaggregate analysis of port selection. *Transportation Research Part E: Logistics and Transportation Review.* 40 (4) July 2004: 317-337. Available from: Science Direct (Accessed 30 November 2010)
Mangan J. 2012. *Global Logistics and Supply Chain Management*. Chichester: Wiley
Mangan, J., C. Lalwani and B. Fynes. 2008. P*ort-centric logistics.* *International Journal of Logistics Management*, The, 19 (1): 29 – 41. Available from Emerald (Accessed 25 March 2012)
Marcus. 2003. The International Liner Industry: Overview and challenges, working paper. Cambrigde, MiT
Marlow, P.B. and A. C. Paixao. 2003. Measuring lean ports performance. *International Journal of Transport Management*, 1 (4): 189–202. Available from: Science Direct (Accessed 10 April)
Muthiah, K. V.. 2010. *Logistics Management and World Seaborne Trade*. Mumbai: Himalaya Pub. House
Nam, H-S and D-W Song. 2011. Defining maritime logistics hub and its implication for container port. *Maritime Policy & Management.*38 (3): 269-292. Available from Taylor and Francis Online (Accessed13 April 2012)
Newbold, P., W.L. Carlson and B. Thorne. 2010. *Statistics for Business and Economics*. New Jersey: Pearson Education Inc
Notteboom, T. E. 2004. Container Shipping and Ports: An Overview, *Review of Network Economics*. 3 (2): 86-106. Available from Port Economics (Accessed 25 March 2012)
Notteboom, T. E. and J-P. Rodrigue. 2004. Port regionalization: towards a new phase in port development. . *Maritime Policy & Management.*32 (3) Available from Taylor and Francis Online (Accessed 25 March 2012)
Nguyen K. T. 2011. Studying port selection on liner routes: An approach from a logistics perspective. *Research in Transportation Economics*, 32 (1), 2011: 39-53 Available from: Science Direct (Accessed 30 November 2011)
Notteboom, T. E. 2010. Concentration and the formation of multi-port gateway regions in the European container port system: an update. *Journal of Transport Geography.* 18 (4): 567-583. Available from Science Direct (Accessed 10 April 2012)
Paixão, A.C. and P.B. Marlow. 2002. Strength and weaknesses of short-sea shipping. *Marine Policy*. 26 (3): 167-178. Available from Science Direct (Accessed 23 April

2012)
Pallant, J. 2007. *SPSS: Survival Manual*. Berkshire: MacGraw-Hill
Pettit, S. J. and A. K. C. Beresford. 2009. From gateways to logistical hubs. *Maritime Policy & Managament.* 36 (3). pages 253-267. Availeble from Taylor and Francis Online (Accessed 25 March 2012)
Rodrigue, J-P, C. Comtois and B. Slack. 2009. *The geography of transport systems*. London: Routeledge
Rushton, Croucher and Baker. 2010. *The handbook of logistics and distribution management*. London: Kogan
Saeed, N.2009. *Competition and Cooperation among Container Terminals in Pakistan: with Emphasis on Game Theoretical Analysis*. Molde: Molde University College
Stopford, M. 2009. *Maritime Economics*. New York: Routledge.
Stopford, M. 2009. *Maritime Economics*. page 81. New York: Routledge.
Tongzon, Dr. J. and L. Sawant. 2007. Port Choice Determinants in a Competitive Environment. *Applied Econimics.* 19 (4-6): 447-492. Available from Taylor and Francis Online (Accessed 30 November 2011)
Tongzon, J.L. 2009. Port Choice and Freight forwarders. *Transportation Research Part E: Logistics and Transportation Review.* 45 (1), January 2009: 186-195. Available from: Science Direct (Accessed 30 November 2010)
The Port of Antwerp. 2011. *Annual rapport*. Available from: http://annualreport2010.portofantwerp.com/en/page/144/antwerp-in-the-rang (Accessed 10 April 2012)
The Port of Antwerp. 2012. Port of Antwerp. http://www.portofantwerp.com/en/port-antwerp (Accessed 13 February 2012)
The Port of Hamburg. 2012. Port of Harmburg. http://www.hafen-hamburg-de/ (Accessed 13 February 2012)
The Port of Rotterdam. 2012. Port of Rotterdam. http://www.portofrotterdam.com (Accessed 13 February 2012)
United Nations. 2005. *Regional shipping port developing strategies*. New York: United Nations Publications
United Nations. 2010. *Review of Maritime Transport 2010*. New York: United Nations Publications
United Nations. 2011. *Review of Maritime Transport 2011*. New York: United Nations Publications
Walliman, Nicholas. 2001. *Your research project.* London: Sage Publication Ltd.
Waters, D. 2009. *Supply chain management: an introduction to logistics*. Basingstoke : Palgrave Macmillan
Waters, D.. 2009. *Supply chain management: an introduction to logistics*. Page 9. Basingstoke: Palgrave Macmillan
Wiegmans B., A.Van Der Hoest and T. Notteboom. 2008. Port and terminal selection by deep-sea container operators. *Maritime Policy and Management.* 35 (6): 517-534. Available from Taylor and Francis Online (Accessed 30 November 2011)
World Shipping Council. 2010. Trade routes. www.worldshipping.org/about-the-industry/global-trade/trade-routes (Accessed 25 March 2012)
Yin, R. K. 2009. *Case Study Research: Design and methods*. Page 26. London: Sage Publications Ltd.

9.0 Appendixes

9.1 Questionnaire

A Survey On

Shipping Line's Selection Criteria of European Container Hubs

A survey by Bernt Christoffer Aaby

MSc Student

Molde University College

N-6402, Molde Norway

Mob: +47 93 02 40 60

E-mail: b.c.aaby@gmail.com / bernt.c.aaby@himolde.no

Dear Sir/Ma`am

I am a Norwegian MSc Student in Logistics. In my master thesis I am researching "Port optimization" and I have taken the three main container hubs in Europe as case studies. This survey is conducted to analyze the Shipping line`s criteria of selection of container terminals, presently calling at the three case ports.

There has prior been conducted little research on this interesting area.

Your company is one of many shipping lines operating lines through the ports selected as case study. Your valuable practical experience will increase my knowledge about port selection criteria`s for shipping lines. As a student, I will highly appreciate your co-operation and assistance in developing a good understanding about this exciting area.

I assure you that the **information you provide will remain strictly confidential, and no individual respondents will be identified**. Your answer is to be combined with answers of other respondents and will be used only for statistical analysis and general discussion.

Please tick if your company wishes to receive the summary of the survey. ☐

Thank you for your upcoming contribution.
Best Regards

Bernt Christoffer Aaby
MSc Student
Molde University College
N-6402, Molde Norway
Tel: +47 93024060
Email: b.c.aaby@gmail.com
bernt.c.aaby@himolde.no

Part A: General Information

Name of shipping company:

.....

Please specify type of shipping line the company is operating:

- ☐ Feeder
- ☐ Deep sea
- ☐ Both

What is the frequency of the vessels of your shipping company at terminals:

.....

Kindly provide the following information for at least three last vessels of shipping line called at terminals:

	Vessel's Type (Geared or Non Geared)	Vessels' Size	Total TEUs contained in Vessel	Total stay (in hours) at Terminal	Port (terminal)	Month & Year
1						
2						
3						

Please indicate how important the following factors are for your shipping company when selecting ports of call? Please answer by putting **one tick in each row** that shows the relative importance.

	Not important 1	Less important 2	Average 3	Important 4	Very important 5
Service Quality	☐	☐	☐	☐	☐
Loading/discharging rate	☐	☐	☐	☐	☐
Handling charges	☐	☐	☐	☐	☐
Number of TEUs handled at the port	☐	☐	☐	☐	☐
Number of ships calling at the port	☐	☐	☐	☐	☐
Level of congestion at the port	☐	☐	☐	☐	☐

	Not important	Less important	Average	Important	Very important
	1	2	3	4	5
Location	☐	☐	☐	☐	☐
Efficiency of the hinterland connections	☐	☐	☐	☐	☐
Personal contacts	☐	☐	☐	☐	☐
Logistical services provided at the port	☐	☐	☐	☐	☐
Storage facilities	☐	☐	☐	☐	☐
Value added services provided at the port	☐	☐	☐	☐	☐
Navigational availability (night navigation)	☐	☐	☐	☐	☐
The cost of switching from one port to another	☐	☐	☐	☐	☐
Investment made by the port to provide better facilities especially for your operations	☐	☐	☐	☐	☐
Investments made at the port by your company to improve efficiency of your operations	☐	☐	☐	☐	☐
Structure of port authorities and ownership	☐	☐	☐	☐	☐

Part B: Ports

Part B1: Port of Rotterdam

Is this port`s terminals always available to shipping line which you represent? (Due to any constraint like non availability of required facilities in terminal, having contract with any other terminal etc, this is possible that any shipping line does not have access to this terminal)

☐ Yes
☐ No

If "No" please state the reason

.....

If "Yes" please proceed on further

Does shipping company use this port?

☐ Yes
☐ No

(If you do not use this terminal, still you can answer the remaining questions based on your past experience or your observations)

Please tell us, how many times vessels of shipping line called at this port during last 3 months?

.....

Kindly mention the handling charges per container at this port

.....

On the next page please use 1-5 ranking (from strongly disagree to strongly agree) for your answer. Please answer the following questions by putting **a tick in the box of each question** that is most closely related.

	Strongly disagree 1	Disagree 2	Average 3	Agree 4	Strongly agree 5
We are satisfied with container loading/discharging rate per hour at this port	☐	☐	☐	☐	☐
The total stay of vessels at berth is not very long	☐	☐	☐	☐	☐
It is very convenient to search the status of Container at this port	☐	☐	☐	☐	☐
We find low frequency of cargo loss and damage	☐	☐	☐	☐	☐
We are satisfied with the availability of equipment other than gantry cranes	☐	☐	☐	☐	☐
Suitable storage facilities are available for storing containers as well as for stuffing and destuffing of goods	☐	☐	☐	☐	☐
This port has the ability to handle large volume of cargo	☐	☐	☐	☐	☐
It is easy for our shipping company to break the relationship with this port and switch to another	☐	☐	☐	☐	☐
This port has made a high level of investments in equipment, tools, services etc or in providing facilities which are used specially by our shipping company	☐	☐	☐	☐	☐
Our shipping line has made investment in equipment, Tools, service etc of this terminal to make service quick and convenient for us	☐	☐	☐	☐	☐
Our shipping company considers and takes into account personal contacts and relationship duration while selecting this port	☐	☐	☐	☐	☐
Our shipping company gives weightage to the location of Port in which this terminal is located before being selected	☐	☐	☐	☐	☐
The hinterland connections from this port is good	☐	☐	☐	☐	☐
Value added services at this port are provided	☐	☐	☐	☐	☐

Part B: Ports

Part B2: Port of Antwerp

Is this port`s terminals always available to shipping line which you represent? (Due to any constraint like non availability of required facilities in terminal, having contract with any other terminal etc, this is possible that any shipping line does not have access to this terminal)

- ☐ Yes
- ☐ No

If "No" please state the reason

.....

If "Yes" please proceed on further

Does shipping company use this port?

- ☐ Yes
- ☐ No

(If you do not use this terminal, still you can answer the remaining questions based on your past experience or your observations)

Please tell us, how many times vessels of shipping line called at this port during last 3 months?

.....

Kindly mention the handling charges per container at this port

.....

On the next page please use 1-5 ranking (from strongly disagree to strongly agree) for your answer. Please answer the following questions by putting **a tick in the box of each question** that is most closely related.

	Strongly disagree	Disagree	Average	Agree	Strongly agree
	1	2	3	4	5
We are satisfied with container loading/discharging rate per hour at this port	☐	☐	☐	☐	☐
The total stay of vessels at berth is not very long	☐	☐	☐	☐	☐
It is very convenient to search the status of Container at this port	☐	☐	☐	☐	☐
We find low frequency of cargo loss and damage	☐	☐	☐	☐	☐
We are satisfied with the availability of equipment other than gantry cranes	☐	☐	☐	☐	☐
Suitable storage facilities are available for storing containers as well as for stuffing and destuffing of goods	☐	☐	☐	☐	☐
This port has the ability to handle large volume of cargo	☐	☐	☐	☐	☐
It is easy for our shipping company to break the relationship with this port and switch to another	☐	☐	☐	☐	☐
This port has made a high level of investments in equipment, tools, services etc or in providing facilities which are used specially by our shipping company	☐	☐	☐	☐	☐
Our shipping line has made investment in equipment, Tools, service etc of this terminal to make service quick and convenient for us	☐	☐	☐	☐	☐
Our shipping company considers and takes into account personal contacts and relationship duration while selecting this port	☐	☐	☐	☐	☐
Our shipping company gives weightage to the location of Port in which this terminal is located before being selected	☐	☐	☐	☐	☐
The hinterland connections from this port is good	☐	☐	☐	☐	☐
Value added services at this port are provided	☐	☐	☐	☐	☐

Part B: Ports

Part B3: Port of Hamburg

Is this port`s terminals always available to shipping line which you represent? (Due to any constraint like non availability of required facilities in terminal, having contract with any other terminal etc, this is possible that any shipping line does not have access to this terminal)

☐ Yes
☐ No

If "No" please state the reason

.....

If "Yes" please proceed on further

Does shipping company use this port?

☐ Yes
☐ No

(If you do not use this terminal, still you can answer the remaining questions based on your past experience or your observations)

Please tell us, how many times vessels of shipping line called at this port during last 3 months?

.....

Kindly mention the handling charges per container at this port

.....

On the next page please use 1-5 ranking (from strongly disagree to strongly agree) for your answer. Please answer the following questions by putting **a tick in the box of each question** that is most closely related.

	Strongly disagree	Disagree	Average	Agree	Strongly agree
	1	2	3	4	5
We are satisfied with container loading/discharging rate per hour at this port	☐	☐	☐	☐	☐
The total stay of vessels at berth is not very long	☐	☐	☐	☐	☐
It is very convenient to search the status of Container at this port	☐	☐	☐	☐	☐
We find low frequency of cargo loss and damage	☐	☐	☐	☐	☐
We are satisfied with the availability of equipment other than gantry cranes	☐	☐	☐	☐	☐
Suitable storage facilities are available for storing containers as well as for stuffing and destuffing of goods	☐	☐	☐	☐	☐
This port has the ability to handle large volume of cargo	☐	☐	☐	☐	☐
It is easy for our shipping company to break the relationship with this port and switch to another	☐	☐	☐	☐	☐
This port has made a high level of investments in equipment, tools, services etc or in providing facilities which are used specially by our shipping company	☐	☐	☐	☐	☐
Our shipping line has made investment in equipment, Tools, service etc of this terminal to make service quick and convenient for us	☐	☐	☐	☐	☐
Our shipping company considers and takes into account personal contacts and relationship duration while selecting this port	☐	☐	☐	☐	☐
Our shipping company gives weightage to the location of Port in which this terminal is located before being selected	☐	☐	☐	☐	☐
The hinterland connections from this port is good	☐	☐	☐	☐	☐
Value added services at this port are provided	☐	☐	☐	☐	☐

9.2. Call sheet

Call sheet

Hello sir / ma`am

My name is Bernt Christoffer Aaby. I'm a Norwegian student. I study Master in Science of logistics and am on my final term.

In this context I`m writing a master thesis.

My topic is Liner`s Selection Criteria`s of European Regional Distribution Centre.

There has prior been conducted little research on this field, which makes this an interesting and exciting field of research.

- The result of this thesis can be helpful for port authorities to improve the efficiency and productivity.
- The thesis shall empirical examine the users` selection criteria's through distributing questionnaires to a selected segment users of predetermined ports.
- The questionnaire is constructed to detect through use of statistical analysis which selection criteria`s that are the main factors of attractiveness when choosing a port.

The survey will be distributed to 70 shipping companies which are operating lines through three selected European ports.

The ports are Rotterdam, Hamburg and Antwerp.

I hope you can help me by answering the questionnaire.

The questionnaire could either be filled out on paper or electronically.

Thank you for the conversation

Bye Bye

9.3. *Reference letter*

Molde University College
Specialized University in Logistics

To whom it might concern

Your ref:
Our ref:
Official in charge:
Extn: +47 71214000
Telefax: +47 71214100
Email: post@hiMolde.no
Molde: 16th January 2012

RESEARCH SURVEY FOR BERNT CHRISTOFFER AABY

Dear Sir/Madam

Bernt Christoffer Aaby is a Master candidate at this University whose research topic is "*An analysis of users' selection criteria when choosing a port*". His research study focuses the Shipping Line's criteria of selection when choosing a port, calling at European Ports.

Since the needed information for his study is available through the Questionnaires filled by Shipping lines, we request you to help him to conduct the research survey that will support the results of his study. The conduction of the study is of significant importance not only to the Shipping and Port Profession but to the economy of the countries as well.

The executive summary of his research will be made available to you upon request.

Molde University College will be pleased to furnish any required information with regard to this study if asked to do that.

Thank you for your cooperation,

Naima Saeed

Naima Saeed
Associate Professor

Faculty of Economics, Informatics and Social Sciences
Molde University College
P.O.Box 2110,6402 Molde, NORWAY
Tel: (+47) 71 21 42 34
E-mail: naima.saeed@himolde.no

9.4. Respondents found in mapping process

Shipping lines found in mapping process calling: Rotterdam, Antwerp and Hamburg

1	ACL
2	ALIANCA
3	ANL
4	APL
5	ATLANTICARGO
6	Baco liner
7	Borchard
8	B.G. Freight Line B.V.
9	CCNI
10	CHINA SHIPPING
11	Chipolbrok
12	CMA CGM
13	Comanov
14	Containerships
15	Cosco
16	CSAV
17	DAL
18	DELMAS
19	DFDS Lysline
20	ECL
21	EIMSKIP
22	EUCON
23	EUROAFRICA
24	Evergreen
25	Feederlines nl
26	FEEDERLINK
27	FESCO ESF Euroservice
28	Grimaldi
29	Hamburg Süd
30	Hanjin
31	Hapag Lloyd
32	HDS line
33	HMM
34	HS-containerline
35	ICL
36	Imtc
37	IRISL
38	Iscont line ldt
39	ITALIA MARITTI-MA
40	K-LINE
41	MacAndrews
42	MACS
43	Maersk line
44	Mann Lines
45	Marfret
46	Merilinja
47	MISC
48	MSC
49	MOL
50	NAVALIS
51	NCL
52	NDS
53	Nirit
54	NSC ARKHANGELSK
55	NYK
56	OOCL
57	OPDR
58	Oy Hacklin Seatrans Ltd
59	PIL
60	Port line
61	Safmarin
62	Samskip
63	SCI
64	Sea connect
65	SLF
66	STINNES
67	Swan line
68	Swire shipping
69	Team lines
70	Transatlantic
71	Tschudi Logitics
72	TURKON LINE
73	UASC
74	Unifeeder
75	Van Uden Maritime
76	Vertraco
77	WANHAI
78	WEC lines
79	Yang Ming
80	ZIM